NATIONALGEOGRAPHIC.COM/MAGAZINE APRIL 2004

NATIONAL GEOGRAPHIC

CHASING TORNADOES

A TALE OF SCIENCE, GUTS, AND LUCK

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PLUS Bird Migration Map

Supplement to NATIONAL GEOGRAPHIC, April 2004

Bird Migration

EASTERN HEMISPHERE

Produced by National Geographic Maps for National Geographic Magazine

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Washington, D.C., April 2004

It's a sky-watcher's dream. Billions of Asian and European birds take flight each fall as internal signals—triggered by shorter days, waning food supplies, and harsh weather—herald hard times to come. Partial migrants touch down after a brief trip. Others fly for thousands of miles, toughing out or dodging the hemisphere's east-west mountain ranges and desolate deserts, many ending in Africa or at Antarctica's icy edge. When nature's rhythms shift, survivors fly north to breed, and the cycle continues. Prompted by climate and landmass changes at the end of the last ice age, this migration is at least 15,000 years old and still evolving. Scientists using the latest technologies are learning just how it works.

Migration Flyways

Colors show generalized flyways, by bird group, representing complex migration patterns.

- LAND BIRDS
- WATERFOWL (DUCKS, GEESE, AND SWANS)
- SHORE AND WADING BIRDS
- SEABIRDS
- BIRDS OF PREY

Selected Bird Routes

- Individual bird tracked by satellite or other means (image shows tracked bird)
- Route derived from banding (or ringing) recoveries and field observations

Where to See Birds

- Bird-watching site (popular spot for observing migratory birds)
- Staging area (vital stopover site where birds rest and refuel during migration)
- Staging area and bird-watching site

Bird length figures reflect average measurements from head to tail. Bird art depicts males except for grey phalarope.

Winkel Tripel Projection
SCALE 1:36,800,000 or 1 INCH = 581 MILES
0 km 500 1000
0 km 500

WILD FOWL

The idea of migration flyways came from monitoring waterfowl, so married are they to traditional routes. Bewick's swans, which breed on the Russian tundra, take predictable paths at summer's end to wintering areas in the Netherlands or Britain (the easternmost population goes to China), often arriving on the same date as the year before. A late start for Andrei, a male tracked in 2003, may have been due to an unusually mild northern autumn. He was last spotted in western Denmark before his satellite transmitter failed—a common hazard of bird tracking.

MAN TAILS BIRD

From bird-watching, netting, and banding (or ringing) to radio and satellite tracking—the effective but pricey technologies that provided data for many routes on this map—people have found ways to keep up with birds. The latest development? Some ornithologists now use weather surveillance radar to locate key staging areas from which flocks take off en masse, resembling a storm on the screen. Radar can't distinguish between species, so data supplied by other means (such as satellite tracking and sound recordings) help complete the picture. One reason it all matters? Once conservationists learn where birds congregate, they can help protect the turf.

THE GREATEST BARRIER

Some five million birds a year overcome 1,400 miles of Sahara desert, the most daunting natural obstacle to migration. Having conquered the Mediterranean Sea or Asian and Arabian deserts, most birds cross the Sahara via western or central corridors where food and water are most plentiful, keeping to higher, cooler altitudes.

AMBUSH FROM ABOVE

Here's a twist, a bird that's a migration peril to other birds. In late summer Eleonora's falcons hover on winds high over the Mediterranean. In mid-air they'll snatch fat songbirds en route to Africa (20,000 falcons may kill ten million in a season). The falcons actually delay breeding until later in the summer than other birds to exploit this mobile food source.

WHERE THE BIRDS ARE

The Dead Sea Valley hosts the world's largest concentration of migrants. As many as a billion birds, exhausted from over-desert flights between Africa and Europe or Asia, refuel near the Red Sea. Birds cause more than half the aircraft accidents in these skies. Conservationists are working to restore marsh habitat destroyed by development.

SOUTH FOR THE WINTER

The winter influx of birds to Africa is unparalleled. Some 4.5 billion of 185 species make the trip. If they survive the Sahara, many touch down first on the Sahel's savannas and grasslands, timing stops to the rhythms of rains and insect blooms. During drought, bugs are scarce, so birds gobble berries from swamps and river valleys. Continuing south, they disperse to fill vacancies, most avoiding the rain forests packed with nonmigrating birds.

SOARING BIRDS OF PREY

Ill equipped for long overseas flights, most raptors funnel across narrow stretches of water. Each year more than 100,000 European honey buzzards flying in long strings between Europe and points south of the Sahara cross at Gibraltar (buzzard No. 41504, tracked from Germany to Nigeria, was no exception), and some 850,000 birds originating farther east have been recorded migrating via the Red Sea. Similarly, lesser spotted eagles, the distance champions of European raptors (covering over 12,000 miles a year), pass through the Bosporus, Levant, and Suez on their way to and from southern Africa. Tracked from Germany, female eagle No. 27999 ended her journey in southern Mozambique near Maputo.

GETTING WARMER?

Recent decades have seen temperate birds' ranges creeping north with warming temperatures. Some egg-laying and migrating schedules also have shifted to follow new insect population peaks. Birds that can't keep up with environmental changes face a bleak future.

NORTHERN LIVING

Siberia's forbidding high Arctic actually bustles with life along its wetland-rich Arctic Ocean coast. The Siberian coastal tundra—the only intact band of tundra in Asia—supports about 50 bird species, mostly web-footed, including five threatened species. Most migrants here travel on well-defined routes from points northeast to southwest as far as Africa.

HABITATS LOST

Where humans compete with wildlife, birds often lose. In Asia human development has left a quarter of the bird species vulnerable or declining, with no end in sight. South Korea's Saemangeum wetland, a vital waterbird staging area, may be converted to agriculture. Oil exploration in Russia and plans for more dams on China's Yangtze River threaten eastern Siberian cranes' breeding and wintering homes.

HAVEN FOR THE FLIGHTLESS

The Volga River Delta is a hideout for many waterfowl in molt. Unlike most birds, which lose feathers over time, waterfowl drop their flight feathers in bulk, rendering them flightless and vulnerable. They're equipped with a molt migration in July to predator-free areas of the Volga, where they await new plumage and fatten heartily before scattering for the winter.

A TALL ORDER

The massive Himalaya don't stop bar-headed geese, whose astonishing flight at 30,000 feet takes them over the range, mostly to India. Many other birds choose migratory divides, longer routes that skirt the mountains.

LANDINGS OF THE LOST

For a migrant that's been confused by fog or blown off course, a headland or island such as Taiwan is a welcome landing site. Last birds along the Pacific rim, they also take refuge at Shiretoko National Park or Shinhama Bird Reserve in Japan, China's Yangtze estuary, or the Mai Po marshes in Hong Kong.

FROM SHORE AND MARSH

Some of the longest distance and most route-loyal migrants are shore and wading birds. Take the white stork. Scientists tracked Princess by satellite on her 6,800-mile trip to South Africa. She and 600,000 of her kind generally avoid wide expanses of water with an easterly route via the Bosporus and Dead Sea Valley, while a smaller number go south via Gibraltar. A few now stay in Europe, feeding at dumps and rice fields. Endangered Siberian cranes also go separate ways: The tiny western flock winters in Iran; the eastern flock, with more than 2,500 birds, in China's Poyang Lake region. The cranes' future depends on wetland protection, but captive breeding and reintroduction, including training young birds to migrate behind ultralights, may also boost populations.

NOMADS DOWN UNDER

Less than 15 percent of Australia's and New Zealand's land birds are true migrants, most flying north to New Guinea or Indonesia. The rest make small, local moves to take advantage of the least and weather conditions. More than 35 of the Northern Hemisphere's arctic species migrate south to Australia, and many seabirds come from Antarctica to escape the winter cold.

WINGS OVER EAST ASIA

Perhaps the most threatened of the world's migration is one I due to a mushrooming human pop ulace. The East Asian flyway reaches from Alaska and the Siberian Arctic through East Asia down to Australia and New Zealand, touching 20 countries along the way and crossing long stretches over the Pacific. Mostly shorebirds and seabirds use these skies, including the bar-tailed godwit, thought to fly nonstop from Alaska to New Zealand.

LAND LOVERS

Today's satellite transmitters are too bulky for many land birds, but decades of banding and bird recoveries have revealed their routes. The widespread barn swallow, a spring-heralding migrant breeding in Eurasia, North Africa, and North America and dipping far south of each, thrives where insects swarm. Massive communal roosts can hold tens of thousands of swallows, which are at home on farms and other human-altered land. Meanwhile, the Alaska flock of the northern wheatear, whose distribution has shifted north and east from Europe since the last ice age, is genetically driven to fly its ancestral path to sub-Saharan Africa (some 13,000 miles) despite suitable winter habitat closer to home.

WINGS OVER WATER

So adapted are some seabirds to ocean life that they may only come to land to breed. Soaring on winds and gliding between wave crests, a wandering albatross—with the longest wingspan (up to 11 feet) of any bird—spends about 70 percent of its life over water. Between breedings it may travel more than 20,000 miles, including foraging trips of hundreds of miles each. Few enter the North Atlantic, where the calm doldrums can trap a seabird for life, but in the southern oceans winds blow furiously, keeping wanderers aloft. Scientists tagged and tracked one such migrant, named Storm, which began its circumpolar journey from South Georgia island, loitering over the Tasman Sea before crossing the Pacific to Chilean waters.

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Supplement to NATIONAL GEOGRAPHIC, April 2004

Bird Migration
WESTERN HEMISPHERE

They slice through the skies by the billions on yearly migrations in search of endless summer. And it seems these lands were meant for the birds: The north promises springs of plenty; fall routes south are clearly marked by food-rich coastlines, rivers, and north-south mountain ranges whose buoying updrafts give birds a lift. In ribbons and waves, from hummingbirds to hawks, they travel transient skyways up to 25,000 miles long on wings woven of delicate feather and hollow bone. It is surely one of nature's most moving performances.

WET AND WILD

Master travelers, shore and wading birds go to extremes. Among cranes, sandhills are the most abundant species at around 600,000 birds. Lesser sandhills boast the farthest crane migration, breeding throughout the Arctic and wintering as far south as northern Mexico. But some stop short: Crane No. 5891 stayed put in Texas. During breeding, populations disperse to exploit habitat pockets, but at staging areas like Nebraska's Platte River, the birds flock in abundance—some going a thousand miles out of their way to join the crowd.

Watch the sandhill crane migration and learn about these magnificent birds at **nationalgeographic.com/magazine/cranecam**

DUCK, DUCK, GOOSE

Many waterfowl are at home on the tundra, and the brant nests about as far north as they go. Tracked from the Yukon Delta, black brant No. 7737 joined thousands of its kind to gorge on the birds' dietary staple of eelgrass at Alaska's Izembek Lagoon, where some now stay all winter (perhaps due to global warming). The majority catch tailwinds for a nonstop, 3,000-mile Pacific flight to the Baja peninsula, an effort that can cut their weight by a third. Threats to eelgrass habitat put these geese at risk.

RAPT HUNTERS

With the greatest of grace, migratory birds of prey soak up miles with their wings. Soaring along coasts and inland waterways, peregrine falcons dwell on every continent but Antarctica. Their name means "wanderer" and, indeed many go the distance: Hazel was tracked from Canada's Baffin Island to Argentina's Pampas and back, her return flight taking her just east of the Mississippi River Delta. Others may cross through Texas in the spring after lingering along the prey-rich shores of the Caribbean and Gulf of Mexico.

ALOFT ON WINDY SEAS

It's hard to fathom, but a single arctic tern might travel 25,000 miles—nearly the circumference of the globe—in its round-trip migration, the longest in the world. As autumn approaches high-latitude breeding grounds, many Atlantic populations of these seabirds parallel Africa's west coast while heading south to enjoy Antarctica's warmest months. Tern movement at that point is uncertain. Feeding as the pack ice retreats, some may fly a circuitous route entirely around Antarctica until poised for the long trip north.

LOYAL TO THE LAND

Banding (or ringing) and recovery gives spotty data, but it's still the best way to track land birds too tiny for satellite tags—like ruby-throated hummingbirds. These wee but strong fliers summer in Canada and the eastern U.S. where deciduous and mixed forests reign, and typically winter from Mexico into Central America. Incredibly, many double their bulk before heading south. Some wing it across the Gulf of Mexico; others take an overland route skirting the Gulf. Spring migration is timed to exploit key flowering plants that bloom as the hummers whir north.

UP, UP, AND AWAY

Have wings, will travel. But *why* do so many birds make such arduous journeys? Most move to seek longer days, plentiful food, and kinder weather. What's remarkable is how they do it, navigating, often under night's cover, by an internal magnetic compass and external markers—stars, mountains, and rivers, for example. The travelers even undergo behavioral and physiological changes, including a modified diet and metabolism.

Though banding and tracking studies suggest basic, mappable flyways, most birds fly in broad fronts rather than narrow bands, while routes may loop, wander, dogleg, or leapfrog, and can change under environmental strain. Take global warming. Its effects on local environmental conditions are already influencing when and where some birds go. But general migratory patterns are deeply ingrained, and change takes time. Just how quickly migration routes will evolve to meet the future is still up in the air.

AN OCEAN VIEW

Water, water everywhere, yet a tiny percentage of migrating birds make transoceanic flights. Those that do, mainly seabirds and shorebirds, may perform stunning months-long round-the-world or Pole-to-Pole journeys. Taxing weather or land barriers may force wavy flight patterns rather than straight lines, and birds will change lanes to find helpful winds or a hearty meal.

PLYING THE PACIFIC COAST

A mild climate keeps many native Pacific birds from migrating far, if at all. But through-bound fliers take advantage of turbulent coastal currents, which roil with plankton and fish—a nourishing seafood soup for weary travelers. Such coastlines (along with the sun and stars) also offer visual cues to birds trying to stay on course.

DOWN FROM THE ARCTIC

Where summer means 24-hour sun, life is good: The water-loving birds that breed here find a land of bounty. But deadly Arctic winters send most flitting south on short jaunts or coursing afar to South America, Africa, even Australia.

PRAIRIES AND PLAINS

Vital migrant habitat includes the prairie-pothole region at the U.S.–Canada frontier—primary breeding ground for waterfowl. For shorebirds, wetlands at Cheyenne Bottoms in Kansas are one of the most utilized inland stopovers in the Northern Hemisphere. Together the Great Plains and Mississippi Valley host vast numbers of the birds that traverse this continent.

THE GREAT NORTH WOODS

In swaths of spruce, birch, and bog from Alaska to Newfoundland, boreal forest is breeding ground for shorebirds, millions of waterfowl, and nearly a third of all North American songbirds. But humans are chipping away at this life-giving habitat: In Canada alone nearly 60 million acres of forest were logged in the past three decades.

THE GULF: WHICH WAY?

Birds unfit for the 600-mile-wide Gulf of Mexico zip down through Central America and return via the Gulf Coast. But others, including more than 50 songbird species, prefer the over-Gulf haul, taking off when tailwinds blow.

LOOP THE LOOP

To exploit the most favorable winds and food supplies, birds may fly in a giant ellipse called a loop migration, curving south over the Atlantic and north over the Gulf, for example. This strategy has evolved independently in many species.

TROPICAL GETAWAY

Balmy weather and better food lure northern temperate breeders to winter in Mexico, the West Indies, or Central or South America. Ancestors of these neotropical migrants likely originated down south, expanding north after the last ice age to reduce competition.

INSIDE AMAZONIA

Despite rampant deforestation, this environment still supports one of the most species-diverse resident bird populations in the world, where birds are specialized to fill rain forest niches. Relatively few migrants winter here, perhaps ill suited to compete with well-adapted locals. Amazonian birds themselves may exhibit some migratory behavior, but it is poorly understood.

FROM PATAGONIA ON UP

Down here, where seasons are the reverse of those up north, migration is flipped—flowing from breeding sites in the temperate south to winter spots near the Tropic of Capricorn and even north of the Equator. More than 250 species take part in this austral migration.

GONE FISHING

Off the coasts of Peru and Chile, upwellings bring riches to the surface. Birds compete with fishermen when prey is plentiful (in non-El Niño years), dooming some to injury or death from entrapment in nets and lines.

BIG BAD THREATS

Migration is a risky business. Birds may get eaten, shot, slammed by winds, or lost—and die of exhaustion or hunger. Pollutants from industry and agriculture take a toll, while a city's bright lights can interfere with navigation, resulting in shocking damage. It's estimated that more than a hundred million disoriented migrants die each year when they collide with high-rise windows.

Migration Flyways

Colors show generalized flyways, by bird group, representing complex migration patterns.

- LAND BIRDS
- WATERFOWL (DUCKS, GEESE, AND SWANS)
- SHORE AND WADING BIRDS
- SEABIRDS
- BIRDS OF PREY

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- Bird-watching site (popular spot for observing migratory birds)
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- Staging area and bird-watching site

Bird length figures reflect average measurements from head to tail. Bird art depicts males except for red-necked phalarope, snow bunting, and upland goose.

Bipolar Oblique Projection
SCALE 1:23,126,000 or 1 INCH = 365 MILES
0 mi 500
0 km 500

Tufted puffin — *Fratercula cirrhata* — Breeds northeast Siberia to California; Winters North Pacific Ocean; Length 16 in (40 cm)

Bristle-thighed curlew — *Numenius tahitiensis* — Breeds western Alaska; Winters Pacific islands; Length 17 in (42 cm)

King eider — *Somateria spectabilis* — Breeds coastal Arctic; Winters northern Atlantic and Pacific Oceans; Length 22 in (56 cm)

Sanderling — *Calidris alba* — Breeds Arctic region; Winters coastal regions worldwide; Length 8 in (20 cm)

Snow bunting — *Plectrophenax nivalis* — Breeds high Arctic; Winters southern Canada, U.S.; central Europe to eastern Asia; Length 6 in (16 cm)

American tree sparrow — *Spizella arborea* — Breeds Arctic region; Winters southern Canada and U.S.; Length 6 in (14 cm)

Wilson's storm-petrel — *Oceanites oceanicus* — Breeds Antarctic and subantarctic regions; Winters North Atlantic, Indian, and Pacific Oceans; Length 7 in (18 cm)

Greater shearwater — *Puffinus gravis* — Breeds South Atlantic islands; Winters North Atlantic; Length 19 in (48 cm)

Blue-gray gnatcatcher — *Polioptila caerulea* — Breeds eastern to southwest U.S.; Winters lower Colorado River to Central America; Florida to West Indies; Length 4 in (11 cm)

Black-throated blue warbler — *Dendroica caerulescens* — Breeds Nova Scotia to Great Lakes and Appalachian Mts.; Winters West Indies; Length 5 in (13 cm)

Sandhill crane — *Grus canadensis* — Breeds Siberia and North America; Winters southern Canada to northern Mexico; Length 42 in (107 cm)

Hudsonian godwit — *Limosa haemastica* — Breeds Alaska to Hudson Bay; Winters southern South America to Tierra del Fuego; Length 15 in (39 cm)

Golden-winged warbler — *Vermivora chrysoptera* — Breeds Great Lakes, Appalachian Mts.; Winters Central America to northern South America; Length 5 in (12 cm)

Red-eyed vireo — *Vireo olivaceus* — Breeds Canada and eastern U.S.; southern S. America; Winters Amazonia; Length 5 in (13 cm)

Short-eared owl — *Asio flammeus* — Breeds North and South America; Europe and northern Asia; Winters southern North America and South America; Europe, North Africa, and southern Asia; Length 15 in (38 cm)

Osprey — *Pandion haliaetus* — Breeds northern North America; northern Europe and Asia; Winters south of Tropic of Cancer worldwide; Length 23 in (58 cm)

Bobolink — *Dolichonyx oryzivorus* — Breeds southern Canada and northern U.S.; Winters eastern Bolivia to northern Argentina; Length 7 in (18 cm)

Blackburnian warbler — *Dendroica fusca* — Breeds southern Canada, northeast U.S., and Appalachian Mts.; Winters Costa Rica to Venezuela and Peru; Length 5 in (12 cm)

Ruby-throated hummingbird — *Archilochus colubris* — Breeds Canada and eastern U.S.; Winters southern Mexico to Costa Rica; Length 4 in (9 cm)

Baltimore oriole — *Icterus galbula* — Breeds southern Canada to eastern U.S.; Winters southern Mexico to Colombia; Length 7 in (18 cm)

American redstart — *Setophaga ruticilla* — Breeds New England and Nova Scotia to Great Lakes; Winters West Indies to western Mexico and northern South America; Length 5 in (12 cm)

Rose-breasted grosbeak — *Pheucticus ludovicianus* — Breeds central to eastern North America; Winters Mexico to northern S. America; Length 8 in (20 cm)

Cliff swallow — *Hirundo pyrrhonota* — Breeds North America; Winters southern Brazil to central Argentina; Length 5 in (13 cm)

Dickcissel — *Spiza americana* — Breeds central U.S.; Winters southern Mexico to northern South America; Length 6 in (15 cm)

Bicknell's thrush — *Catharus bicknelli* — Breeds New England to Gulf of St. Lawrence; Winters northern West Indies; Length 6 in (16 cm)

Yellow-browed tyrant — *Satrapa icterophrys* — Breeds Pampas to Venezuela and eastern Brazil; Winters central S. America; Length 6 in (16 cm)

Yellow-billed cuckoo — *Coccyzus americanus* — Breeds eastern U.S., Mexico, and West Indies; Winters east of Andes; Length 12 in (30 cm)

Mississippi kite — *Ictinia mississippiensis* — Breeds southern U.S.; Winters Paraguay and northern Argentina; Length 14 in (36 cm)

Fork-tailed flycatcher — *Tyrannus savana* — Breeds southern Mexico to southern S. America east of Andes; Winters northern South America to northern Argentina; Length 15 in (39 cm)

Chocolate-vented tyrant — *Neoxolmis rufiventris* — Breeds Patagonia; Winters to Uruguay; Length 9 in (23 cm)

Green-backed firecrown — *Sephanoides sephanoides* — Breeds Chile and western Argentina to Tierra del Fuego; Winters central Argentina; Length 4 in (10 cm)

Upland goose — *Chloephaga picta* — Breeds southern Argentina; Winters northern Argentina; Length 26 in (66 cm)

American golden-plover — *Pluvialis dominica* — Breeds Hudson Bay to Alaska; Winters southern South America; Length 10 in (26 cm)

Rufous hummingbird — *Selasphorus rufus* — Breeds northwest N. America; Winters Mexico; Length 4 in (9 cm)

Western tanager — *Piranga ludoviciana* — Breeds western North America; Winters California to Costa Rica; Length 7 in (18 cm)

Townsend's warbler — *Dendroica townsendi* — Breeds northwestern North America; Winters west coast U.S.; northern Mexico to Costa Rica; Length 5 in (12 cm)

Brant (brent goose) — *Branta bernicla* — Breeds coastal Arctic; Winters coastal North America, eastern Asia, and northwestern Europe; Length 24 in (62 cm)

Sora — *Porzana carolina* — Breeds Canada and northern U.S.; Winters southern U.S. to northern South America; Length 9 in (22 cm)

Lazuli bunting — *Passerina amoena* — Breeds southwestern Canada to Mexico; Winters Arizona and western Mexico; Length 6 in (14 cm)

Blue-winged teal — *Anas discors* — Breeds Canada and U.S.; Winters southern U.S. to South America; Length 15 in (38 cm)

Olive-sided flycatcher — *Contopus cooperi* — Breeds Canada, Alaska, and western U.S.; Winters northern Andes; Length 7 in (19 cm)

Chilean swallow — *Tachycineta leucopyga* — Breeds Chile and southern Argentina; Winters northern Argentina and Uruguay; Length 5 in (13 cm)

Peregrine falcon — *Falco peregrinus* — Breeds worldwide; Winters worldwide; some in Northern Hemisphere migrate to Southern Hemisphere; Length 17 in (42 cm)

Surfbird — *Aphriza virgata* — Breeds Alaska and Yukon; Winters Pacific coast of the Americas; Length 9 in (24 cm)

Swainson's hawk — *Buteo swainsoni* — Breeds western Canada to northern Mexico; Winters southern S. America; Length 20 in (52 cm)

Red-necked phalarope — *Phalaropus lobatus* — Breeds Arctic and subarctic regions; Winters tropical coastal regions; Length 7 in (19 cm)

Sabine's gull — *Xema sabini* — Breeds high Arctic coasts; Winters off western South America; off western Africa; Length 13 in (33 cm)

Two-banded plover — *Charadrius falklandicus* — Breeds Patagonia; Winters northern Chile and Uruguay; Length 7 in (18 cm)

Long-tailed jaeger — *Stercorarius longicaudus* — Breeds high Arctic region; Winters South Atlantic and southeast Pacific; Length 22 in (56 cm)

Buller's shearwater — *Puffinus bulleri* — Breeds islands off New Zealand; Winters Pacific Ocean; Length 18 in (46 cm)

Arctic tern — *Sterna paradisaea* — Breeds Arctic region; Winters Antarctic region and subantarctic coasts; Length 13 in (34 cm)

Ruby-throated hummingbird, migration south July to September, returning north March to May

Sandhill crane, tagged 5891, migration August 1999 to May 2000

Brant, tagged 7737, migration August 1999 to May 2000

Peregrine falcon, named Hazel, migration September 1994 to July 1995

Wandering albatross named Storm, migration June to December 1998 (Albatross art on reverse side)

Departs Aug. 1999, Returns May 2000

Departs Sept. 1994, Returns July 1995

Departs June 1998, Returns December 1998

Winters Nov. 1999 to March 2000

Winters Nov. 1984 to March 1995

Departs July, Returns May

Winters Sept. to March

Departs Aug. 1998, Returns May 2000

Aug. 22 to Nov. 2, 1999

Aug. 24 – Aug. 29 – May 22 – Sept. 6 – Sept. 10 – Sept. 14 – Sept. 18 – May 18 – May 15 – Sept. 22 – May 10 – Apr. 16 – Apr. 11 – Oct. 29 – Mar. 16 – May 1 – May 15 – May 8 – Aug. 26 – Mar. 11 – May 10 – Apr. 15 – Aug. 23 – Mar. 28 – May 23 – May 19 – Oct. 11 – Oct. 14 – Mar. 20 – May 7 – Mar. 10 – May 3 – Oct. 24 – Oct. 30 – November 3 – Apr. 28 – Apr. 20 – Nov. 9 – Apr. 16 – Nov. 12 – Apr. 12 – Nov. 15 – Nov. 26 – Nov. 15 – Nov. 30 – Dec. 2 – Dec. 3 – June 7 – June 8

Aleutian Islands; Izembek Lagoon; Yukon River Delta; Kvichak Bay; Kachemak Bay; Redoubt Bay; Copper River Delta; Alaska Range; Arctic refuge; Yukon Flats; Old Crow Flats; Mackenzie River Delta; Banks Island; Pt. Barrow; Wrangel Island; Chukchi Sea; Beaufort Sea; Parry Islands; Ellesmere Island; Greenland; Baffin Bay; Baffin Island; Bylot Island; Queen Maud Gulf; Foxe Basin; Foxe Basin Islands; Dewey Soper; Akpatok Island; Ammassalik; Iceland; Shore & Wading Birds; Davis Strait; Seabirds; Labrador Sea; Birds of Prey; Hudson Bay; Churchill; Gannet Islands; Island of Newfoundland; Witless Bay; Cape St. Mary's; Bonaventure Island; Gulf of St. Lawrence; Kouchibouguac Nat. Park; Cape Breton Island; Bay of Fundy; Nova Scotia; Cap Tourmente; Grand Manan Archipelago; New England; Parker River refuge; Cape Cod; Derby Hill; Hamlin Beach; Point Pelee Nat. Park; Lake Erie Marshlands; Hawk Mountain; Delaware Bay; Cape May; Chesapeake Bay; Delmarva Peninsula; Cape Hatteras; Outer Banks; Whitefish Point; Horicon Marsh; Cedar Grove; Mark Twain refuge; Squaw Creek refuge; Cheyenne Bottoms; Lower Cache River Complex; Salt Plains refuge; Buffalo Lake refuge; Bitter Lake refuge; Hawk Ridge; Rice Lake refuge; Devils Lake; Springfield Bottoms; Great Salt Lake; Lahontan Valley; Mono Lake; Grasslands; Sacramento refuge; Klamath Basin; Deer Flat refuge; Tule Lake; Humboldt Bay; Point Reyes; Farallon Islands; San Francisco Bay; Elkhorn Slough; Point Conception; Mugu Lagoon; Channel Islands; San Diego Bay; Butterbredt Spring; Lower Colorado River; Salton Sea; Colorado River Delta; Bosque del Apache refuge; San Pedro; Scammon Lagoon; Kino Bay; Big Bend Nat. Park; Bahia Santa Maria; San José Estuary; Mazatlán; San Blas; Marismas Nacionales; Sierra de Manantlán; Veracruz coastal plain; El Cofre de Perote Nat. Park; Los Tuxtlas; Maya Biosphere Reserve; Northern Belize; Cerro San Gil; Belize; Guatemala; Honduras; Nicaragua; Cabo Negro; Kekoldi; Costa Rica; Panama; Panama Bay; Galápagos Islands; Ecuador; Ecuasal ponds; Mindo; Madreselva; Podocarpus National Park; Peru; Paracas; Manu Nat. Park; Apolobamba; Mejia Lagoons; Bolivia; Kaa-Iya del Gran Chaco National Park; Río Negro Pantanal; Laguna Salada; Paraguay; Asunción Bay; La Serena; Laguna Mar Chiquita; Lagoa do Peixe; Uruguay; Punta Rasa; Chile; Argentina; Bahía de San Antonio; Isla Grande de Chiloé; Bahía Lomas; Bahía de San Sebastián; Tierra del Fuego; Cape Horn; Falkland Islands; South Georgia; Drake Passage; Antarctic Peninsula; Ssi Sinú River Delta; Los Olivitos swamp; Tayrona Nat. Park; Henri Pittier National Park; Unare Lagoon; Trinidad; Venezuela; Los Nevados Nat. Park; Colombia; Bigi Pan; Wia Wia reserve; Coppename; Guyana; Suriname; French Guiana; Guiana Highlands; Maranhão coast; Amazonia; Brazil; Brazilian Highlands; South America; Atacama Desert; Gran Chaco; Pampas; Patagonia; Andes; Llanos; Orinoco; Amazon; Paraná; Pilcomayo; Paraguay; Tropic of Cancer; Tropic of Capricorn; Equator; Caribbean Sea; Cuba; Jamaica; Hispaniola; Puerto Rico; Cabo Rojo refuge; Dominica; Yucatán; Sierra Madre del Sur; Sierra Madre Occidental; Sierra Madre Oriental; Rocky Mountains; Great Plains; Great Basin; Great Lakes; Great Bear Lake; Great Slave Lake; Lake Athabasca; Peace-Athabasca Delta; Frederick Island; Scott Islands; Vancouver Island; Fraser River Delta; Padilla Bay; Grays Harbor; Coos Bay; Willamette Valley; Creston Valley; Benton Lake refuge; Beaverhill Lake; Quill Lakes; Last Mountain Lake; Aransas refuge; Padre Island; Laguna Madre; Columbia Bottomlands; High Island; Mississippi River Delta; Lower Suwannee refuge; Lake Apopka; Everglades Nat. Park; Florida Keys; Florida; Gulf of Mexico; Yazoo refuge; Canada; North America; United States; Alaska; Yukon; Arizona; Colorado Plateau; Texas; Coast Mountains; Cascade Range; Sierra Nevada; Baja California; Land Birds; Waterfowl; Seabirds; Shore & Wading Birds; Birds of Prey; Mississippi Flyway; Pacific Flyway; Atlantic Flyway; Central Flyway; Sandhill crane 5891; Brant 7737; Peregrine falcon Hazel; Ruby-throated hummingbird; Wandering albatross Storm; from Eastern Hemisphere; to Eastern Hemisphere

Arctic Ocean; Russia; Asia; Siberia; Canada; North America; United States; Mexico; Central America; South America; Brazil; Amazonia; Brazilian Highlands; West Indies; Caribbean Sea; Greenland; Iceland; Arctic Ocean; Europe; Asia; Palearctic; Nearctic; Atlantic Ocean; Pacific Ocean; Indian Ocean; Oceania; Australia; Africa; Afrotropic; Indo-Malayan; Neotropic; Australasia; Antarctica; Antarctic; Arctic tern migration in the Atlantic Ocean; Seabird migration routes; Biogeographical region boundary; June; August; May; September; October; December; March

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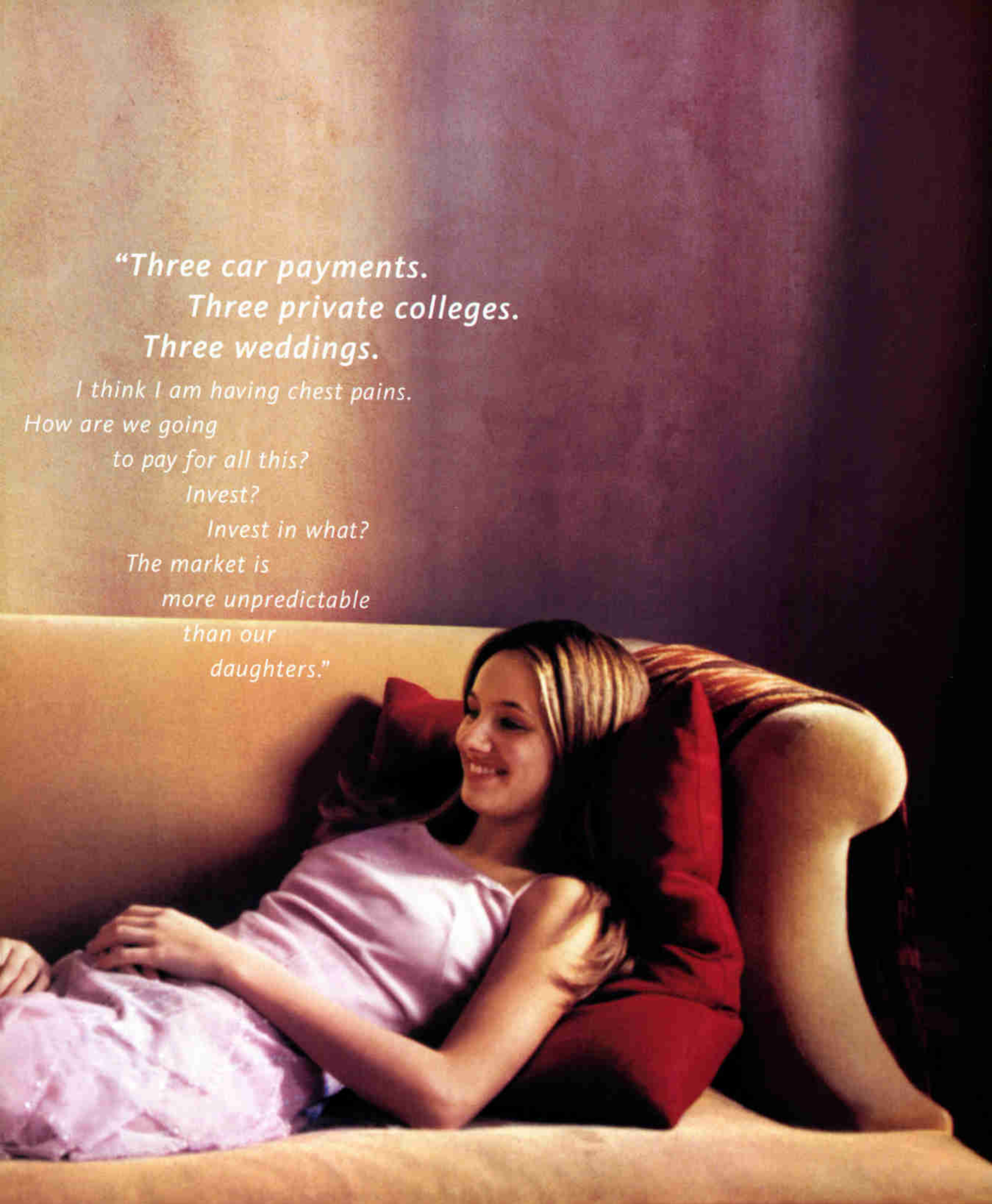
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"Three car payments.
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Three weddings.
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How are we going
to pay for all this?
Invest?
Invest in what?
The market is
more unpredictable
than our
daughters."



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Mediterranean Spur-thighed Tortoise *(Testudo graeca)*
Size: Head and body length averages 12-17 cm **Weight:** Averages 580-1,000 g
Habitat: Forests, dry open steppes and barren hillsides up to 1,700 m
Surviving number: Unknown; populations declining

Photographed by José Luis Gómez de Francisco

WILDLIFE AS CANON SEES IT

House proud? The Mediterranean spur-thighed tortoise has a right to be. Thanks to its gorgeously patterned, always-there shelter—and its ability to take in almost all the moisture it needs from vegetation—it is able to weather tough semi-arid environments. This particular mobile home is largely immobile much of the year. In the hot summer months the tortoise aestivates, going into a period of inactivity and lowered metabolism. In the northern part of its range it also hibernates the winter away. But being a homebody is getting more dangerous all the time as it faces habitat destruction and the threat of capture for the pet trade.

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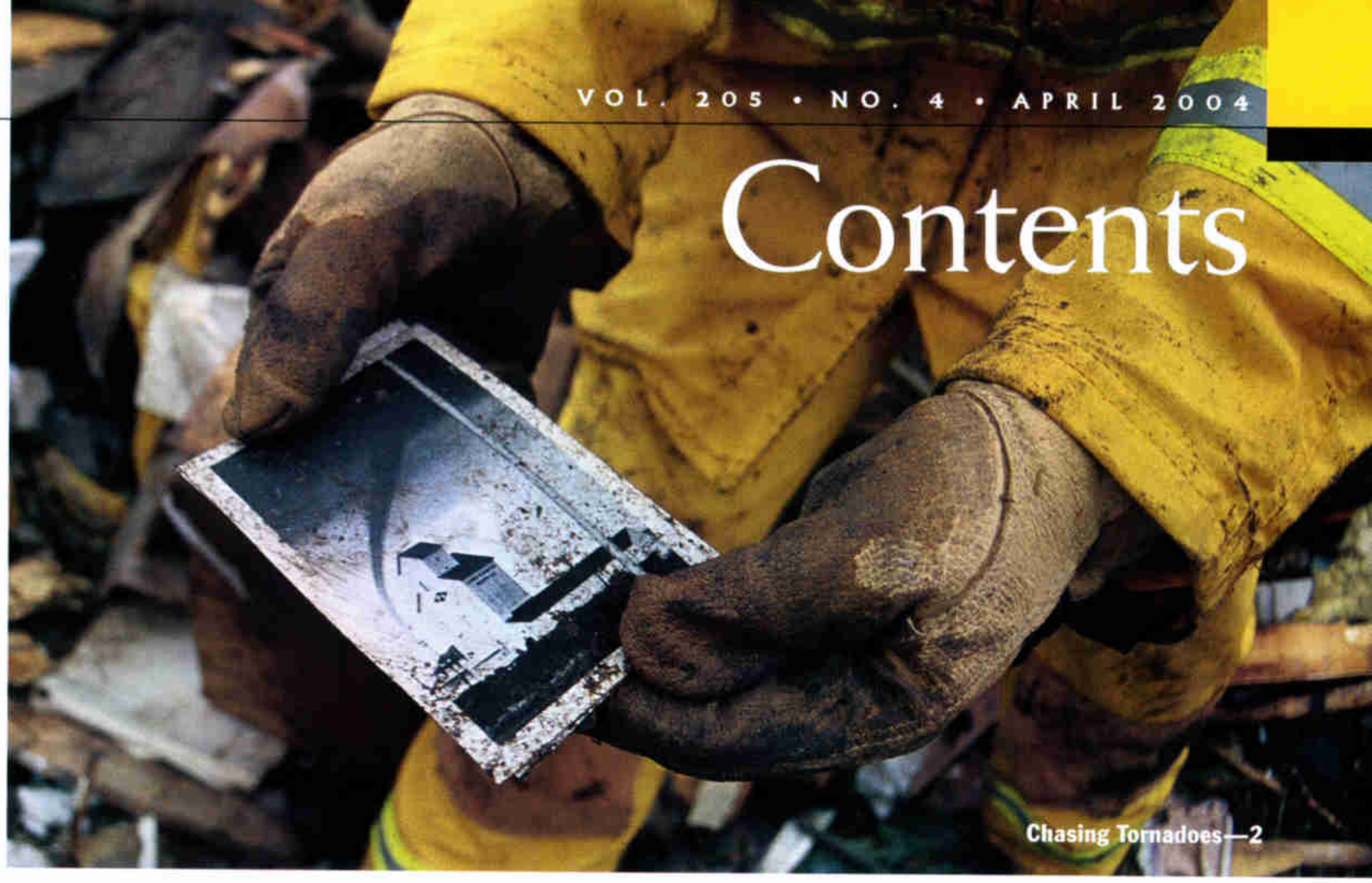
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Canon has teamed up with the Yellowstone Park Foundation to help scientists protect Yellowstone's wildlife through advanced imaging technologies.

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BY CARSTEN PETER

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Your view of the world will change forever after you've experienced *Culture Shock Week,* where notions of beauty, power, and sex are all in flux. Episodes look at cultural ideals of attractiveness, from foot binding to teeth filing, in a show on *Beauty;* the blurred boundaries of sexuality in *The Third Gender;* and the training of 21st-century Japanese girls entering the venerated world of the teahouse in *Secrets of a Geisha.* You'll even venture to Papua New Guinea, where headhunting (right) and cannibalism were once traditions.





FRIDAY, APRIL 9, 8 P.M. ET/9 P.M. PT
SAT. & SUN., APRIL 10 & 11, 8 P.M. ET/PT

Quest for Truth

The foundations of Christian belief inspire these Easter week films. *Inside the Vatican* presents a rare view of the ceremonies (left) and daily life at the nucleus of the Roman Catholic Church. Other shows examine the Shroud of Turin, Noah's Flood, and the tomb of Jesus.

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From the volcano that may have spawned the legend of Atlantis to hidden pyramids in Peru, *NGC Presents,* a weekly two-hour odyssey, showcases the best of National Geographic Channel.

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Dawn of the Maya

In the tangled jungle of northern Guatemala lie clues to the origin of the great Maya civilization. A one-hour special follows archaeologists as they excavate its magnificent Preclassic ruins, from an elaborate carved mask to temples that may hold tombs of early Maya kings to a stunning mural depicting a Maya creation myth.

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FROM TOP: CHARLES O'REAR, CORBIS; PLINIO LEPRI, AP PHOTO; JOHN LIVZEY, NGT&F; FRANS LANTING

Fighting Back with Aricept®



Mom's forgetfulness turned out to be Alzheimer's. But we didn't just sit here and do nothing.

*I got her to a doctor right away and he put her on ARICEPT.® Now she's doing better.**

If a person forgets names, places or facts – and has trouble with everyday things like reading or shopping – it may not be normal aging. It could be Alzheimer's disease. So it's important to see a doctor as soon as you can.

There is no cure for Alzheimer's. But a prescription drug called ARICEPT® has been used by millions of people to help their symptoms.

In studies, ARICEPT® has been proven to work for mild to moderate Alzheimer's. It has helped people improve their memory over time. It has also helped them to keep doing everyday things on their own, longer.

Ask your doctor if ARICEPT® is right for you or your loved one. It is the #1 prescribed drug for Alzheimer's in the world. The sooner you know it's Alzheimer's, the sooner ARICEPT® can help.

ONCE-A-DAY

ARICEPT®

(donepezil HCl)

5-MG AND 10-MG TABLETS

Strength in the face of Alzheimer's™

To learn more and to receive a memory checklist,
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or visit www.aricept.com

Memory Checklist

*Individual responses to ARICEPT® can be different – people may get better, stay the same or not get better.

ARICEPT® is well tolerated but may not be for everyone. Some people may experience nausea, diarrhea, not sleeping well, vomiting, muscle cramps, feeling very tired, or not wanting to eat. In studies, these side effects were usually mild and went away over time. Some people taking ARICEPT® may experience fainting. People at risk for ulcers should tell their doctors because their condition may get worse.

Please see additional important product information on accompanying page.

ONCE-A-DAY

ARICEPT® (donepezil HCl) 5-MG AND 10-MG TABLETS

STRENGTH IN THE FACE OF ALZHEIMER'S™

ARICEPT® (Donepezil Hydrochloride Tablets)

Brief Summary—see package insert for full prescribing information. **INDICATIONS AND USAGE** ARICEPT® is indicated for the treatment of mild to moderate dementia of the Alzheimer's type. **CONTRAINDICATIONS** ARICEPT® is contraindicated in patients with known hypersensitivity to donepezil hydrochloride or to piperidine derivatives. **WARNINGS *Anesthesia:*** ARICEPT®, as a cholinesterase inhibitor, is likely to exaggerate succinylcholine-type muscle relaxation during anesthesia. ***Cardiovascular Conditions:*** Because of their pharmacological action, cholinesterase inhibitors may have vagotonic effects on the sinoatrial and atrioventricular nodes. This effect may manifest as bradycardia or heart block in patients both with and without known underlying cardiac conduction abnormalities. Syncopal episodes have been reported in association with the use of ARICEPT®. ***Gastrointestinal Conditions:*** Through their primary action, cholinesterase inhibitors may be expected to increase gastric acid secretion due to increased cholinergic activity. Therefore, patients should be monitored closely for symptoms of active or occult gastrointestinal bleeding, especially those at increased risk for developing ulcers, e.g., those with a history of ulcer disease or those receiving concurrent nonsteroidal anti-inflammatory drugs (NSAIDS). Clinical studies of ARICEPT® have shown no increase, relative to placebo, in the incidence of either peptic ulcer disease or gastrointestinal bleeding. ARICEPT®, as a predictable consequence of its pharmacological properties, has been shown to produce diarrhea, nausea and vomiting. These effects, when they occur, appear more frequently with the 10 mg/day dose than with the 5 mg/day dose. In most cases, these effects have been mild and transient, sometimes lasting one to three weeks, and have resolved during continued use of ARICEPT®. ***Genitourinary:*** Although not observed in clinical trials of ARICEPT®, cholinomimetics may cause bladder outflow obstruction. ***Neurological Conditions:*** Seizures: Cholinomimetics are believed to have some potential to cause generalized convulsions. However, seizure activity also may be a manifestation of Alzheimer's Disease. ***Pulmonary Conditions:*** Because of their cholinomimetic actions, cholinesterase inhibitors should be prescribed with care to patients with a history of asthma or obstructive pulmonary disease. **PRECAUTIONS Drug-Drug Interactions *Drugs Highly Bound to Plasma Proteins:*** Drug displacement studies have been performed *in vitro* between this highly bound drug (96%) and other drugs such as furosemide, digoxin, and warfarin. ARICEPT® at concentrations of 0.3-10 µg/mL did not affect the binding of furosemide (5 µg/mL), digoxin (2 ng/mL), and warfarin (3 µg/mL) to human albumin. Similarly, the binding of ARICEPT® to human albumin was not affected by furosemide, digoxin, and warfarin. ***Effect of ARICEPT® on the Metabolism of Other Drugs:*** No *in vivo* clinical trials have investigated the effect of ARICEPT® on the clearance of drugs metabolized by CYP 3A4 (e.g. cisapride, terfenadine) or by CYP 2D6 (e.g. imipramine). However, *in vitro* studies show a low rate of binding to these enzymes (mean K_i about 50-130 µM), that, given the therapeutic plasma concentrations of donepezil (164 nM), indicates little likelihood of interference. Whether ARICEPT® has any potential for enzyme induction is not known. ***Effect of Other Drugs on the Metabolism of ARICEPT®:*** Ketoconazole and quinidine, inhibitors of CYP450, 3A4 and 2D6, respectively, inhibit donepezil metabolism *in vitro*. Whether there is a clinical effect of these inhibitors is not known. Inducers of CYP 2D6 and CYP 3A4 (e.g., phenytoin, carbamazepine, dexamethasone, rifampin, and phenobarbital) could increase the rate of elimination of ARICEPT®. ***Use with Anticholinergics:*** Because of their mechanism of action, cholinesterase inhibitors have the potential to interfere with the activity of anticholinergic medications. ***Use with Cholinomimetics and Other Cholinesterase Inhibitors:*** A synergistic effect may be expected when cholinesterase inhibitors are given concurrently with succinylcholine, similar neuromuscular blocking agents or cholinergic agonists such as bethanechol. **Carcinogenesis, Mutagenesis, Impairment of Fertility** Carcinogenicity studies of donepezil have not been completed. Donepezil was not mutagenic in the Ames reverse mutation assay in bacteria. In the chromosome aberration test in cultures of Chinese hamster lung (CHL) cells, some clastogenic effects were observed. Donepezil was not clastogenic in the *in vivo* mouse micronucleus test. Donepezil had no effect on fertility in rats at doses up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m² basis). **Pregnancy *Pregnancy Category C:*** Teratology studies conducted in pregnant rats at doses up to 16 mg/kg/day (approximately 13 times the maximum recommended human dose on a mg/m² basis) and in pregnant rabbits at doses up to 10 mg/kg/day (approximately 16 times the maximum recommended human dose on a mg/m² basis) did not disclose any evidence for a teratogenic potential of donepezil. However, in a study in which pregnant rats were given up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m² basis) from day 17 of gestation through day 20 postpartum, there was a slight increase in still births and a slight decrease in pup survival through day 4 postpartum at this dose; the next lower dose tested was 3 mg/kg/day. There are no adequate or well-controlled studies in pregnant women. ARICEPT® should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nursing Mothers** It is not known whether donepezil is excreted in human breast milk. ARICEPT® has no indication for use in nursing mothers. **Pediatric Use** There are no adequate and well-controlled trials to document the safety and efficacy of ARICEPT® in any illness occurring in children. **ADVERSE REACTIONS Adverse Events Leading to Discontinuation** The rates of discontinuation from controlled clinical trials of ARICEPT® due to adverse events for the ARICEPT® 5 mg/day treatment groups were comparable to those of placebo-treatment groups at approximately 5%. The rate of discontinuation of patients who received 7-day escalations from 5 mg/day to 10 mg/day, was higher at 13%. The most common adverse events leading to discontinuation, defined as those occurring in at least 2% of patients and at twice the incidence seen in placebo patients, are shown in Table 1.

Table 1. Most Frequent Adverse Events Leading to Withdrawal from Controlled Clinical Trials by Dose Group

Dose Group	Placebo	5 mg/day ARICEPT®	10 mg/day ARICEPT®
Patients Randomized Event/%Discontinuing	355	350	315
Nausea	1%	1%	3%
Diarrhea	0%	<1%	3%
Vomiting	<1%	<1%	2%

Most Frequent Adverse Clinical Events Seen in Association with the Use of ARICEPT® The most common adverse events, defined as those occurring at a frequency of at least 5% in patients receiving 10 mg/day and twice the placebo rate, are largely predicted by ARICEPT®'s cholinomimetic effects. These include nausea, diarrhea, insomnia, vomiting, muscle cramp, fatigue and anorexia. These adverse events were often of mild intensity and transient, resolving during continued ARICEPT® treatment without the need for dose modification. There is evidence to suggest that the frequency of these common adverse events may be affected by the rate of titration. An open-label study was conducted with 269 patients who received placebo in the 15- and 30-week studies. These patients were titrated to a dose of 10 mg/day over a 6-week period. The rates of common adverse events were lower than those seen in patients titrated to 10 mg/day over one week in the controlled clinical trials and were comparable to those seen in patients on 5 mg/day. See Table 2 for a comparison of the most common adverse events following one and six week titration regimens.

Table 2. Comparison of Rates of Adverse Events in Patients Titrated to 10 mg/day Over 1 and 6 Weeks

	No titration		One-week titration	Six-week titration
Adverse Event	**Placebo (n=315)**	**5 mg/day (n=311)**	**10 mg/day (n=315)**	**10 mg/day (n=269)**
Nausea	6%	5%	19%	6%
Diarrhea	5%	8%	15%	9%
Insomnia	6%	6%	14%	6%
Fatigue	3%	4%	8%	3%
Vomiting	3%	3%	8%	5%
Muscle cramps	2%	6%	8%	3%
Anorexia	2%	3%	7%	3%

Adverse Events Reported in Controlled Trials The events cited reflect experience gained under closely monitored conditions of clinical trials in a highly selected patient population. In actual clinical practice or in other clinical trials, these frequency estimates may not apply, as the conditions of use, reporting behavior, and the kinds of patients treated may differ. Table 3 lists treatment emergent signs and symptoms that were reported in at least 2% of patients in placebo-controlled trials who received ARICEPT® and for which the rate of occurrence was greater for ARICEPT® assigned than placebo assigned patients. In general, adverse events occurred more frequently in female patients and with advancing age.

Table 3. Adverse Events Reported in Controlled Clinical Trials in at Least 2% of Patients Receiving ARICEPT® (donepezil HCl) and at a Higher Frequency than Placebo-treated Patients

Body System/Adverse Event	Placebo (n=355)	ARICEPT® (n=747)
Percent of Patients with any Adverse Event	**72**	**74**
Body as a Whole		
Headache	9	10
Pain, various locations	8	9
Accident	6	7
Fatigue	3	5
Cardiovascular System		
Syncope	1	2
Digestive System		
Nausea	6	11
Diarrhea	5	10
Vomiting	3	5
Anorexia	2	4
Hemic and Lymphatic System		
Ecchymosis	3	4
Metabolic and Nutritional Systems		
Weight Decrease	1	3
Musculoskeletal System		
Muscle Cramps	2	6
Arthritis	1	2
Nervous System		
Insomnia	6	9
Dizziness	6	8
Depression	<1	3
Abnormal Dreams	0	3
Somnolence	<1	2
Urogenital System		
Frequent Urination	1	2

Other Adverse Events Observed During Clinical Trials ARICEPT® has been administered to over 1700 individuals during clinical trials worldwide. Approximately 1200 of these patients have been treated for at least 3 months and more than 1000 patients have been treated for at least 6 months. Controlled and uncontrolled trials in the United States included approximately 900 patients. In regards to the highest dose of 10 mg/day, this population includes 650 patients treated for 3 months, 475 patients treated for 6 months and 116 patients treated for over 1 year. The range of patient exposure is from 1 to 1214 days. Treatment emergent signs and symptoms that occurred during 3 controlled clinical trials and two open-label trials in the United States were recorded as adverse events by the clinical investigators using terminology of their own choosing. To provide an overall estimate of the proportion of individuals having similar types of events, the events were grouped into a smaller number of standardized categories using a modified COSTART dictionary and event frequencies were calculated across all studies. These categories are used in the listing below. The frequencies represent the proportion of 900 patients from these trials who experienced that event while receiving ARICEPT®. All adverse events occurring at least twice are included, except for those already listed in Tables 2 or 3, COSTART terms too general to be informative, or events less likely to be drug caused. Events are classified by body system and listed using the following definitions: *frequent adverse events*—those occurring in at least 1/100 patients; *infrequent adverse events*—those occurring in 1/100 to 1/1000 patients. These adverse events are not necessarily related to ARICEPT® treatment and in most cases were observed at a similar frequency in placebo-treated patients in the controlled studies. No important additional adverse events were seen in studies conducted outside the United States.

Body as a Whole: *Frequent:* influenza, chest pain, toothache; *Infrequent:* fever, edema face, periorbital edema, hernia hiatal, abscess, cellulitis, chills, generalized coldness, head fullness, listlessness. **Cardiovascular System:** *Frequent:* hypertension, vasodilation, atrial fibrillation, hot flashes, hypotension; *Infrequent:* angina pectoris, postural hypotension, myocardial infarction, AV block (first degree), congestive heart failure, arteritis, bradycardia, peripheral vascular disease, supraventricular tachycardia, deep vein thrombosis. **Digestive System:** *Frequent:* fecal incontinence, gastrointestinal bleeding, bloating, epigastric pain; *Infrequent:* eructation, gingivitis, increased appetite, flatulence, periodontal abscess, cholelithiasis, diverticulitis, drooling, dry mouth, fever sore, gastritis, irritable colon, tongue edema, epigastric distress, gastroenteritis, increased transaminases, hemorrhoids, ileus, increased thirst, jaundice, melena, polydipsia, duodenal ulcer, stomach ulcer. **Endocrine System:** *Infrequent:* diabetes mellitus, goiter. **Hemic and Lymphatic System:** *Infrequent:* anemia, thrombocythemia, thrombocytopenia, eosinophilia, erythrocytopenia. **Metabolic and Nutritional Disorders:** *Frequent:* dehydration; *Infrequent:* gout, hypokalemia, increased creatine kinase, hyperglycemia, weight increase, increased lactate dehydrogenase. **Musculoskeletal System:** *Frequent:* bone fracture; *Infrequent:* muscle weakness, muscle fasciculation. **Nervous System:** *Frequent:* delusions, tremor, irritability, paresthesia, aggression, vertigo, ataxia, increased libido, restlessness, abnormal crying, nervousness, aphasia; *Infrequent:* cerebrovascular accident, intracranial hemorrhage, transient ischemic attack, emotional lability, neuralgia, coldness (localized), muscle spasm, dysphoria, gait abnormality, hypertonia, hypokinesia, neurodermatitis, numbness (localized), paranoia, dysarthria, dysphasia, hostility, decreased libido, melancholia, emotional withdrawal, nystagmus, pacing. **Respiratory System:** *Frequent:* dyspnea, sore throat, bronchitis; *Infrequent:* epistaxis, post nasal drip, pneumonia, hyperventilation, pulmonary congestion, wheezing, hypoxia, pharyngitis, pleurisy, pulmonary collapse, sleep apnea, snoring. **Skin and Appendages:** *Frequent:* pruritus, diaphoresis, urticaria; *Infrequent:* dermatitis, erythema, skin discoloration, hyperkeratosis, alopecia, fungal dermatitis, herpes zoster, hirsutism, skin striae, night sweats, skin ulcer. **Special Senses:** *Frequent:* cataract, eye irritation, vision blurred; *Infrequent:* dry eyes, glaucoma, earache, tinnitus, blepharitis, decreased hearing, retinal hemorrhage, otitis externa, otitis media, bad taste, conjunctival hemorrhage, ear buzzing, motion sickness, spots before eyes. **Urogenital System:** *Frequent:* urinary incontinence, nocturia; *Infrequent:* dysuria, hematuria, urinary urgency, metrorrhagia, cystitis, enuresis, prostate hypertrophy, pyelonephritis, inability to empty bladder, breast fibroadenosis, fibrocystic breast, mastitis, pyuria, renal failure, vaginitis. **Postintroduction Reports** Voluntary reports of adverse events temporally associated with ARICEPT® that have been received since market introduction that are not listed above, and that there is inadequate data to determine the causal relationship with the drug include the following: abdominal pain, agitation, cholecystitis, confusion, convulsions, hallucinations, heart block (all types), hemolytic anemia, hepatitis, hyponatremia, neuroleptic malignant syndrome, pancreatitis, and rash. **OVERDOSAGE Because strategies for the management of overdose are continually evolving, it is advisable to contact a Poison Control Center to determine the latest recommendations for the management of an overdose of any drug.** As in any case of overdose, general supportive measures should be utilized. Overdosage with cholinesterase inhibitors can result in cholinergic crisis characterized by severe nausea, vomiting, salivation, sweating, bradycardia, hypotension, respiratory depression, collapse and convulsions. Increasing muscle weakness is a possibility and may result in death if respiratory muscles are involved. Tertiary anticholinergics such as atropine may be used as an antidote for ARICEPT® overdosage. Intravenous atropine sulfate titrated to effect is recommended: an initial dose of 1.0 to 2.0 mg IV with subsequent doses based upon clinical response. Atypical responses in blood pressure and heart rate have been reported with other cholinomimetics when co-administered with quaternary anticholinergics such as glycopyrrolate. It is not known whether ARICEPT® and/or its metabolites can be removed by dialysis (hemodialysis, peritoneal dialysis, or hemofiltration). Dose-related signs of toxicity in animals included reduced spontaneous movement, prone position, staggering gait, lacrimation, clonic convulsions, depressed respiration, salivation, miosis, tremors, fasciculation and lower body surface temperature. **DOSAGE AND ADMINISTRATION** The dosages of ARICEPT® shown to be effective in controlled clinical trials are 5 mg and 10 mg administered once per day. The higher dose of 10 mg did not provide a statistically significantly greater clinical benefit than 5 mg. There is a suggestion, however, based upon order of group mean scores and dose trend analyses of data from these clinical trials, that a daily dose of 10 mg of ARICEPT® might provide additional benefit for some patients. Accordingly, whether or not to employ a dose of 10 mg is a matter of prescriber and patient preference. Evidence from the controlled trials indicates that the 10 mg dose, with a one week titration, is likely to be associated with a higher incidence of cholinergic adverse events than the 5 mg dose. In open label trials using a 6 week titration, the frequency of these same adverse events was similar between the 5 mg and 10 mg dose groups. Therefore, because steady state is not achieved for 15 days and because the incidence of untoward effects may be influenced by the rate of dose escalation, treatment with a dose of 10 mg should not be contemplated until patients have been on a daily dose of 5 mg for 4 to 6 weeks. ARICEPT® should be taken in the evening, just prior to retiring, and may be taken with or without food.

Eisai Inc. Teaneck, NJ 07666 · Pfizer U.S. Pharmaceuticals New York, NY 10017

200177 Revised December 2000

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From the Editor



CARSTEN PETER

I grew up in tornado country, and because of that I always keep a weather eye out. Even when I'm in my office in downtown Washington, if the western sky outside my window starts churning, I watch for that ominous green glow I knew in my East Texas childhood. It means chaos is coming.

If weather were a predator, it would be a tornado. When I see even a hint of one in the making, I duck for cover—and so should you. The tornado scientists covered in our story on page 2 are expert storm trackers armed with the latest technology. Even so, their efforts to understand these meteorological monsters—and our efforts to bring back never-before-seen pictures—put the team in real danger. In other words, don't try this at home.

Making this kind of remarkable science possible is as much a part of our mission here at National Geographic as reporting on it. The Society was founded in 1888 as a scientific and educational organization. Since then the scholars we've supported have explored the oceans' deeply held secrets, tracked the fossil record of early man, broken ground in understanding the primate world, and kept a close eye on environmental change and its impact. More and more, our grantees have moved beyond pure science to applied science, using their findings to solve problems—from tracing humankind's ancestry through the genetic record to decoding the forces that give birth to a lethal twister.

Bill Allen

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Forum



December 2003
Our coverage honoring a hundred years of flight generated the most mail. Some readers wondered why we dated the centennial to the Wright brothers, since other innovators have competing claims. Many readers expressed disappointment that their favorite airplanes weren't included on the supplement's illustration of the most influential aircraft in history. Turn the page to learn which we would have added if we'd had more space.

The Future of Flying

The December issue celebrates the centennial of flight, the starting point of which, according to you, was the first attempts of the Wright brothers. As a French reader, I wonder why you didn't publish a similar issue 14 years ago, the centennial of French inventor Clément Ader's 1890 flight in a flying machine called the *Eole.*

JEAN-PAUL GRATIAS
Paris, France

We received mail from supporters of Ader, Brazil's Alberto Santos-Dumont, Romania's Trajan Vuia, and other innovators believed by some to have flown the first true airplane. We stand with the vast majority of world aviation experts, who agree that the Wright brothers were the first to fly in a powered, heavier-than-air machine that achieved controlled, sustained flight with a pilot aboard. The Wright Flyer flew forward without losing speed and landed at a point as high as that from which it started. Ader's 160-foot hop on the Eole *was an important demonstration: It proved that a heavier-than-air, manned plane could take off under its own power. But the controlled and sustained flight of the Wrights distinguished them from other aviation pioneers.*

Surely the second 100 years of aeronautical progress will rival the first in technological development. Yet after factoring in gridlocked airport traffic, distant parking, lengthy check-in procedures, slow-moving security lines, departure and arrival delays, and interminable baggage claim at the end of the trip, a two-hour flight will still translate to a full-day's journey—all the gee-whiz flight technology notwithstanding. But hopefully the little pretzel packet of the future will be tastier.

ROBERT SOLOMON
Brooklyn, New York

In your article on the future of flying, you quote a test pilot telling an old joke about a pilot and a dog ("The pilot's job is to feed

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Supplement: 100 Years of Flight

Your chart missed a monumental piece of history when you neglected to add the Avro CF-105 Arrow interceptor. If Canada had not developed this technological marvel in 1958, the U.S. would not have been able to develop its incredible fighting aircraft.

PAUL R. VISSER
Oakville, Ontario

I would like to express my disappointment at the omission of the Antonov An-225. This Ukrainian giant is the largest plane in the world.

PATRICK O'REILLY
Navan, Meath

I am amazed that you failed to include the B-24 Liberator!

MICHAEL T. MADDEN
Clarksville, Maryland

How can you not put the Vought F4U Corsair on the list? It was one of the fastest prop-driven aircraft during World War II, and it was still flying for the U.S. Navy during the Korean War.

LUCIUS R. OSTHEIMER
Houma, Louisiana

The man who chose the planes for our supplement, former U.S. Air Force historian Richard Hallion, shares your frustration. Coming up with the final list of 47 influential aircraft was a long, agonizing process for Hallion and National Geographic researchers and art directors. At least 40 other planes were considered, including some that readers had hoped to see. If we'd been able to give him a few more square inches of paper, Hallion would also have added the Beech 18 ("it profoundly influenced the growth of business aviation"), the de Havilland D. H. 4 ("used for bombing and reconnaissance in World War I, then for mail transport"), and the Lockheed U-2 ("nearly 50 years after its first flight, this spy plane continues to influence international relations").

the dog, and the dog's job is to bite the pilot if he touches anything" in the cockpit). As a commercial pilot who flies an advanced, highly computerized aircraft, I take issue with even a light-hearted poke at pilots. Perhaps readers should ask themselves how a computer would deal with an engine failure, a cabin fire, or an ill passenger. Pilots are trained to deal with problems such as these in simulators—and sometimes, unfortunately, in real life. The day airlines start flying pilotless aircraft will be the day I stop flying, professionally and personally.

HENRY B. JARZABKOWSKI
Bloomington, Illinois

When I pulled my December 2003 issue from its envelope this evening, all I could think was: Wow! Polyphemus (the cyclops from Homer's *Odyssey*) and Darth Vader must have collided into each other. The F/A-22 Raptor is most impressive.

DAVID MEASHEY
Roanoke, Virginia

The article's feel-good summary sounded particularly hollow given that the text and photos reflect the military's dominant role in the pursuit of these technologies. Let's be honest: The military is concerned with achieving dominance by force. The F/A-22 fighter and B-2 bomber are weapons designed to kill people.

ERIC HALL
Lopez Island, Washington

The idea that military aircraft are evil is hardly startling, because war by its very nature is a cruel thing. But military aviation has provided many benefits. Many improvements in airliners were first conceived in military aircraft. Yes, fighters are designed to kill, but technological advances have also meant that war has become a more clinical thing: It has reduced the death toll among innocent civilians considerably.

BEN SMITH
Hayling Island, Hampshire

FROM OUR ONLINE FORUM
nationalgeographic.com/ngm/0312

The text was well written and balanced. My disappointment

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lies in the selection of the pictures: More than 20 pages of photographs are dedicated to glorifying the military and America's current and future aeronautic power. Only a handful of photos are dedicated to non-military applications.

ERIC S. HOWARD
Cape Elizabeth, Maine

Jamming 500 people into an airplane is not progress.

PATRICK SCHMUDE
Cincinnati, Ohio

FROM OUR ONLINE FORUM
nationalgeographic.com/ngm/0312

The article described how airplanes are going faster, farther, and smarter, but not cleaner. High-flying jet aircraft are known to be a source of atmospheric pollution, yet there was no mention of this in the article, and no reference to technologies for reducing the environmental damage caused by aviation. The future for all transportation systems that rely on fossil fuels must be a move toward environmentally friendly technologies. The aviation industry is no exception.

ANDY LEWIS
Magnetic Island, Queensland

Tango, Soul of Argentina

I don't think that I really understood the meaning of the word "rapture" until I saw the expression caught by photographer Pablo Corral Vega on the perspiring face of José Libertella as he played a tango on the bandoneon.

SPENCER KING
Wasaga Beach, Ontario

The Samurai Way

The rising popularity of samurai culture in modern Japan makes me uneasy. American prisoners of war feared the samurai sword during World War II—a time when the samurai warrior code pervaded the Japanese military—because decapitation by sword was a common punishment. Many civilians, mostly Chinese and Koreans, were also beheaded or bayoneted by the Japanese under the twin banners of the warrior code and obedience to the emperor. This is why General MacArthur confiscated five million swords after the war. To me the samurai warrior is in many ways similar to the Nazis, and shouting *sieg heil* and goose-stepping are frowned upon practices today. The samurai warrior code deserves to be treated the same way.

ROGER HULSTEIN
Whitehorse, Yukon Territory

The aviation article's feel-good summary sounded particularly hollow given that the story reflected the military's dominant role. Let's be honest: The F/A-22 fighter and B-2 bomber are weapons designed to kill people.

Tom O'Neill's wonderful history of the samurai, "Japan's Way of the Warrior," was thrilling. Although the story ends with the sad tale of the demise of the samurai, it is refreshing to learn how the Japanese continue to lift up the samurai warrior spirit. Despite their warring factions, the samurai held a code of honor, duty, and respect that is best emulated in the U.S. today by the Marine Corps. Nearly every man can be a good soldier, but to be a good warrior requires a man of greater strength, prowess, and spirit.

M. VINCENT TURNER
Boston, Massachusetts

Geographica

I love the logic of John Wamsley's solution to the problem of Australia's vanishing native wildlife as described in "Kill a Cat, Save a Numbat?" He advocates killing invasive species such as feral cats. If we follow his idea to its natural conclusion, then if we wanted to restore Australia to its aboriginal splendor, we should kill all the white men. Is Wamsley willing to die to restore the ecosystem that his race has destroyed?

STEPHANIE WOOD
Montclair, New Jersey

ZipUSA: Wichita, Kansas

If this article was supposed to be about one "long day for Beulah Barnes," then she certainly changes clothes more frequently than most people do. I count three different tops in the montage of pictures on pages 132-3.

NOËL CHRISTIAN
Sausalito, California

You're right: Unlike Cher, Beulah Barnes doesn't change costumes several times in one work shift. Photographer Ira Block spent several days photographing her, and she wore something different each day.

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Rev. May 2003a
Brief Summary

ALLEGRA®
(fexofenadine hydrochloride)
Capsules and Tablets

INDICATIONS AND USAGE **Seasonal Allergic Rhinitis** ALLEGRA is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 6 years of age and older. Symptoms treated effectively were sneezing, rhinorrhea, itchy nose/palate/throat, itchy/watery/red eyes. **Chronic Idiopathic Urticaria** ALLEGRA is indicated for treatment of uncomplicated skin manifestations of chronic idiopathic urticaria in adults and children 6 years of age and older. It significantly reduces pruritus and the number of wheals. **CONTRAINDICATIONS** ALLEGRA is contraindicated in patients with known hypersensitivity to any of its ingredients. **PRECAUTIONS** **Drug Interaction with Erythromycin and Ketoconazole** Fexofenadine hydrochloride has been shown to exhibit minimal (ca. 5%) metabolism. However, co-administration of fexofenadine hydrochloride with ketoconazole and erythromycin led to increased plasma levels of fexofenadine hydrochloride. Fexofenadine hydrochloride had no effect on the pharmacokinetics of erythromycin and ketoconazole. In two separate studies, fexofenadine hydrochloride 120 mg twice daily (two times the recommended twice daily dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QT_c interval were observed when patients were administered fexofenadine hydrochloride alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

Effects on steady-state fexofenadine hydrochloride pharmacokinetics after 7 days of co-administration with fexofenadine hydrochloride 120 mg every 12 hours (two times the recommended twice daily dose) in normal volunteers (n=24)

Concomitant Drug	C_{maxSS} *(Peak plasma concentration)*	$AUC_{ss0\text{-}12h}$ *(Extent of systemic exposure)*
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials. The mechanism of these interactions has been evaluated in *in vitro*, *in situ*, and *in vivo* animal models. These studies indicate that ketoconazole or erythromycin co-administration enhances fexofenadine gastrointestinal absorption. *In vivo* animal studies also suggest that in addition to increasing absorption, ketoconazole decreases fexofenadine hydrochloride gastrointestinal secretion, while erythromycin may also decrease biliary excretion. **Drug Interactions with Antacids** Administration of 120 mg of fexofenadine hydrochloride (2 x 60 mg capsule) within 15 minutes of an aluminum and magnesium containing antacid (Maalox®) decreased fexofenadine AUC by 41% and C_{max} by 43%. ALLEGRA should not be taken closely in time with aluminum and magnesium containing antacids. **Carcinogenesis, Mutagenesis, Impairment of Fertility** The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine hydrochloride exposure (based on plasma area-under-the-concentration vs. time [AUC] values). No evidence of carcinogenicity was observed in an 18-month study in mice and in a 24-month study in rats at oral doses up to 150 mg/kg of terfenadine (which led to fexofenadine exposures that were respectively approximately 3 and 5 times the exposure from the maximum recommended daily oral dose of fexofenadine hydrochloride in adults and children). In *in vitro* (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and *in vivo* (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity. In rat fertility studies, dose-related reductions in implants and increases in postimplantation losses were observed at an oral dose of 150 mg/kg of terfenadine (which led to fexofenadine hydrochloride exposures that were approximately 3 times the exposure of the maximum recommended daily oral dose of fexofenadine hydrochloride in adults). **Pregnancy** **Teratogenic Effects: Category C.** There was no evidence of teratogenicity in rats or rabbits at oral doses of terfenadine up to 300 mg/kg (which led to fexofenadine exposures that were approximately 4 and 31 times, respectively, the exposure from the maximum recommended daily oral dose of fexofenadine in adults). There are no adequate and well controlled studies in pregnant women. Fexofenadine should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nonteratogenic Effects.** Dose-related decreases in pup weight gain and survival were observed in rats exposed to an oral dose of 150 mg/kg of terfenadine (approximately 3 times the maximum recommended daily oral dose of fexofenadine hydrochloride in adults based on comparison of fexofenadine hydrochloride AUCs). **Nursing Mothers** There are no adequate and well-controlled studies in women during lactation. Because many drugs are excreted in human milk, caution should be exercised when fexofenadine hydrochloride is administered to a nursing woman. **Pediatric Use** The recommended dose in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adults and pediatric patients and on the safety profile of fexofenadine hydrochloride in both adult and pediatric patients at doses equal to or higher than the recommended doses. The safety of ALLEGRA tablets at a dose of 30 mg twice daily has been demonstrated in 438 pediatric patients 6 to 11 years of age in two placebo-controlled 2-week seasonal allergic rhinitis trials. The safety of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adult and pediatric patients and on the safety profile of fexofenadine in both adult and pediatric patients at doses equal to or higher than the recommended dose. The effectiveness of ALLEGRA for the treatment of seasonal allergic rhinitis in patients 6 to 11 years of age was demonstrated in one trial (n=411) in which ALLEGRA tablets 30 mg twice daily significantly reduced total symptom scores compared to placebo, along with extrapolation of demonstrated efficacy in patients ages 12 years and above, and the pharmacokinetic comparisons in adults and children. The effectiveness of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on an extrapolation of the demonstrated efficacy of ALLEGRA in adults with this condition and the likelihood that the disease course, pathophysiology and the drug's effect are substantially similar in children to that of adult patients. Three clinical safety studies comparing 15 mg BID (n=85) and 30 mg BID (n=330) of an experimental formulation of fexofenadine to placebo (n=430) have been conducted in pediatric patients aged 6 months to 5 years. In general, fexofenadine hydrochloride was well tolerated in these studies. No unexpected adverse events were seen given the known safety profile of fexofenadine and likely adverse reactions for this patient population. (See ADVERSE REACTIONS and CLINICAL PHARMACOLOGY.) The safety and effectiveness of fexofenadine hydrochloride in pediatric patients under 6 years of age have not been established. **Geriatric Use** Clinical studies of ALLEGRA tablets and capsules did not include sufficient numbers of subjects aged 65 years and over to determine whether this population responds differently from younger patients. Other reported clinical experience has not identified differences in responses between the geriatric and younger patients. This drug is known to be substantially excreted by the kidney, and the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and may be useful to monitor renal function. (See CLINICAL PHARMACOLOGY). **ADVERSE REACTIONS** **Seasonal Allergic Rhinitis** **Adults.** In placebo-controlled seasonal allergic rhinitis clinical trials in patients 12 years of age and older, which included 2461 patients receiving fexofenadine hydrochloride capsules at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. All adverse events that were reported by greater than 1% of patients who received the recommended daily dose of fexofenadine hydrochloride (60 mg capsules twice daily), and that were more common with fexofenadine hydrochloride than placebo, are listed in Table 1. In a placebo-controlled clinical study in the United States, which included 570 patients aged 12 years and older receiving fexofenadine hydrochloride tablets at doses of 120 or 180 mg once daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 1 also lists adverse experiences that were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at doses of 180 mg once daily and that were more common with fexofenadine hydrochloride than placebo. The incidence of adverse events, including drowsiness, was not dose-related and was similar across subgroups defined by age, gender, and race.

Table 1
Adverse experiences in patients ages 12 years and older reported in placebo-controlled seasonal allergic rhinitis clinical trials in the United States

Twice daily dosing with fexofenadine capsules at rates of greater than 1%

Adverse experience	*Fexofenadine 60 mg Twice Daily (n=679)*	*Placebo Twice Daily (n=671)*
Viral Infection (cold, flu)	2.5%	1.5%
Nausea	1.6%	1.5%
Dysmenorrhea	1.5%	0.3%
Drowsiness	1.3%	0.9%
Dyspepsia	1.3%	0.6%
Fatigue	1.3%	0.9%

Once daily dosing with fexofenadine hydrochloride tablets at rates of greater than 2%

Adverse experience	*Fexofenadine 180 mg once daily (n=283)*	*Placebo (n=293)*
Headache	10.6%	7.5%
Upper Respiratory Tract Infection	3.2%	3.1%
Back Pain	2.8%	1.4%

The frequency and magnitude of laboratory abnormalities were similar in fexofenadine hydrochloride and placebo-treated patients. **Pediatric.** Table 2 lists adverse experiences in patients aged 6 to 11 years of age which were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at a dose of 30 mg twice daily in placebo-controlled seasonal allergic rhinitis studies in the United States and Canada that were more common with fexofenadine hydrochloride than placebo.

Table 2
Adverse experiences reported in placebo-controlled seasonal allergic rhinitis studies in pediatric patients ages 6 to 11 in the United States and Canada at rates of greater than 2%

Adverse experience	*Fexofenadine 30 mg twice daily (n=209)*	*Placebo (n=229)*
Headache	7.2%	6.6%
Accidental Injury	2.9%	1.3%
Coughing	3.8%	1.3%
Fever	2.4%	0.9%
Pain	2.4%	0.4%
Otitis Media	2.4%	0.0%
Upper Respiratory Tract Infection	4.3%	1.7%

Three clinical safety studies in 845 children aged 6 months to 5 years comparing 15 mg BID (n=85) and 30 mg BID (n=330) of an experimental formulation of fexofenadine to placebo (n=430) have been conducted. In general, fexofenadine hydrochloride was well tolerated in these studies. No unexpected adverse events were seen given the known safety profile of fexofenadine and likely adverse reactions for this patient population. (See PRECAUTIONS Pediatric Use.) **Chronic Idiopathic Urticaria** Adverse events reported by patients 12 years of age and older in placebo-controlled chronic idiopathic urticaria studies were similar to those reported in placebo-controlled seasonal allergic rhinitis studies. In placebo-controlled chronic idiopathic urticaria clinical trials, which included 726 patients 12 years of age and older receiving fexofenadine hydrochloride tablets at doses of 20 to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 3 lists adverse experiences in patients aged 12 years and older which were reported by greater than 2% of patients treated with fexofenadine hydrochloride 60 mg tablets twice daily in controlled clinical studies in the United States and Canada and that were more common with fexofenadine hydrochloride than placebo. The safety of fexofenadine hydrochloride in the treatment of chronic idiopathic urticaria in pediatric patients 6 to 11 years of age is based on the safety profile of fexofenadine hydrochloride in adults and adolescent patients at doses equal to or higher than the recommended dose (see Pediatric Use).

Table 3
Adverse experiences reported in patients 12 years and older in placebo-controlled chronic idiopathic urticaria studies in the United States and Canada at rates of greater than 2%

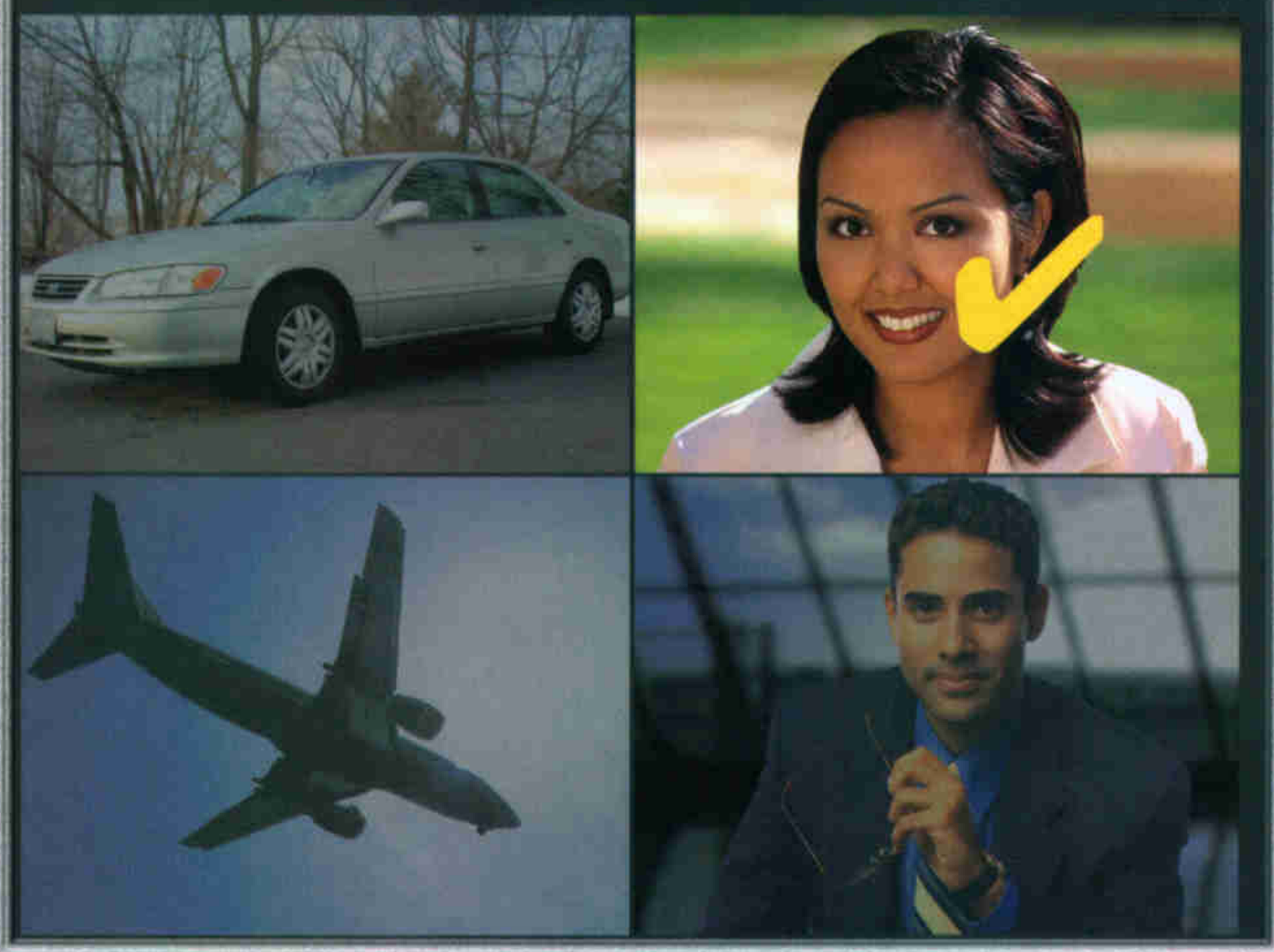
Adverse experience	*Fexofenadine 60 mg twice daily (n=186)*	*Placebo (n=178)*
Back Pain	2.2%	1.1%
Sinusitis	2.2%	1.1%
Dizziness	2.2%	0.6%
Drowsiness	2.2%	0.0%

Events that have been reported during controlled clinical trials involving seasonal allergic rhinitis and chronic idiopathic urticaria patients with incidences less than 1% and similar to placebo and have been rarely reported during postmarketing surveillance include: insomnia, nervousness, and sleep disorders or paroniria. In rare cases, rash, urticaria, pruritus and hypersensitivity reactions with manifestations such as angioedema, chest tightness, dyspnea, flushing and systemic anaphylaxis have been reported. **OVERDOSAGE** Reports of fexofenadine hydrochloride overdose have been infrequent and contain limited information. However, dizziness, drowsiness, and dry mouth have been reported. Single doses of fexofenadine hydrochloride up to 800 mg (six normal volunteers at this dose level), and doses up to 690 mg twice daily for 1 month (three normal volunteers at this dose level) or 240 mg once daily for 1 year (234 normal volunteers at this dose level) were administered without the development of clinically significant adverse events as compared to placebo. In the event of overdose, consider standard measures to remove any unabsorbed drug. Symptomatic and supportive treatment is recommended. Hemodialysis did not effectively remove fexofenadine hydrochloride from blood (1.7% removed) following terfenadine administration. No deaths occurred at oral doses of fexofenadine hydrochloride up to 5000 mg/kg in mice (110 times the maximum recommended daily oral dose in adults and 200 times the maximum recommended daily oral dose in children based on mg/m^2) and up to 5000 mg/kg in rats (230 times the maximum recommended daily oral dose in adults and 400 times the maximum recommended daily oral dose in children based on mg/m^2). Additionally, no clinical signs of toxicity or gross pathological findings were observed. In dogs, no evidence of toxicity was observed at oral doses up to 2000 mg/kg (300 times the maximum recommended daily oral dose in adults and 530 times the maximum recommended daily oral dose in children based on mg/m^2). **DOSAGE AND ADMINISTRATION** **Seasonal Allergic Rhinitis** **Adults and Children 12 Years and Older.** The recommended dose of ALLEGRA is 60 mg twice daily, or 180 mg once daily. A dose of 60 mg once daily is recommended as the starting dose in patients with decreased renal function (see CLINICAL PHARMACOLOGY). **Children 6 to 11 Years.** The recommended dose of ALLEGRA is 30 mg twice daily. A dose of 30 mg once daily is recommended as the starting dose in pediatric patients with decreased renal function (see CLINICAL PHARMACOLOGY). **Chronic Idiopathic Urticaria** **Adults and Children 12 Years and Older.** The recommended dose of ALLEGRA is 60 mg twice daily. A dose of 60 mg once daily is recommended as the starting dose in patients with decreased renal function (see CLINICAL PHARMACOLOGY). **Children 6 to 11 Years.** The recommended dose of ALLEGRA is 30 mg twice daily. A dose of 30 mg once daily is recommended as the starting dose in pediatric patients with decreased renal function (see CLINICAL PHARMACOLOGY).

Please see product circular for full prescribing information.

Rx only

Rev. May 2003a
Brief Summary
Aventis Pharmaceuticals Inc.
Kansas City, MO 64137 USA
US Patents 4,254,129; 5,375,693; 5,578,610
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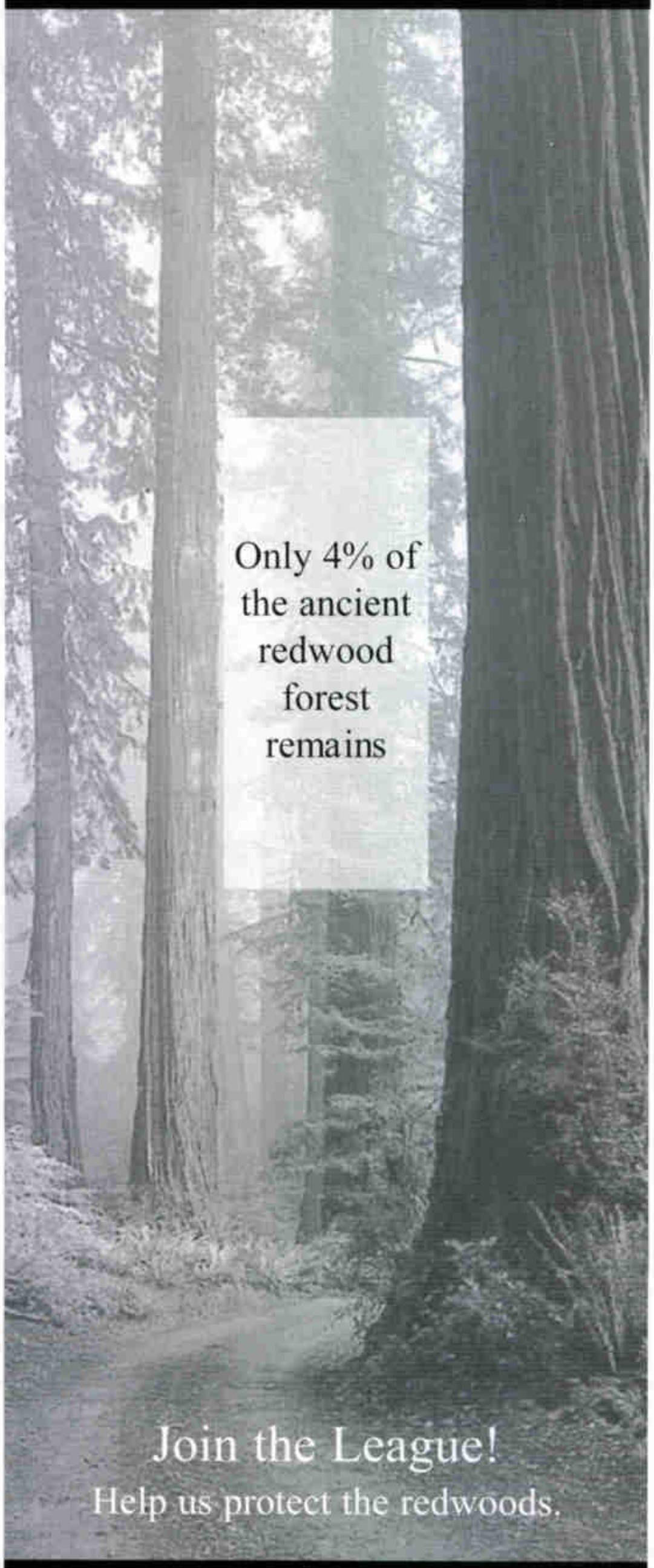


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GEOGRAPHY OF SPORTS

Worldwide, It's a Hit

As markets mushroom, baseball goes global

"For starting pitchers, we have two Dominicans, one Italian, one Mexican, and one Japanese. In the bullpen we have a Venezuelan, a Mexican. . . ." That was manager Tommy Lasorda, unveiling his Los Angeles Dodgers in 1995—at the time an unusual collection of players from around the world. Now, as a new baseball season begins, such a lineup would barely raise an eyebrow. Of the 827 players who opened the 2003 major league season, 28 percent came from foreign countries and Puerto Rico (below).

The injection of international players into America's national pastime coincides with a surge in baseball's popularity worldwide. In recent years the game has swept Asia and is now the hottest new sport in China. At the 2002 Asian Games in Pusan, South Korea, Chinese cheerleaders, at far right,

EMMANUEL DUNAND, AFP/GETTY IMAGES; ART BY DON FOLEY

Country-of-origin stats on Major League Baseball players, April 2003

England
No. of players: 1
Pop. of country (U.K.): 60,094,648

Taiwan
No. of players: 1 (July 2003)
Pop. of country: 22,092,387

Germany
No. of players: 1
Pop. of country: 82,398,326

Vietnam
No. of players: 1
Pop. of country: 81,624,716

Curaçao
No. of players: 2
Pop. of country (Netherlands Antilles): 216,226

Aruba
No. of players: 2
Pop. of country: 70,844

Nicaragua
No. of players: 2
Pop. of country: 5,128,517

Colombia
No. of players: 3
Pop. of country: 41,662,073

Australia
No. of players: 3
Pop. of country: 19,731,984

South Korea
No. of players: 6
Pop. of country: 48,289,037

Panama
No. of players: 7
Pop. of country: 2,960,784

APHICA

CREATURES OF OUR UNIVERSE

Canada
No. of players: 10
Pop. of country:
32,207,113

Mexico
No. of players: 17
Pop. of country:
104,907,991

Puerto Rico (U.S.)
No. of players: 38
Pop. of country:
3,885,877

Dominican Republic
No. of players: 79
Pop. of country:
8,715,602

Cuba
No. of players: 10
Pop. of country:
11,263,429

Japan
No. of players: 11
Pop. of country:
127,214,499

Venezuela
No. of players: 37
Pop. of country:
24,654,694

United States
No. of players: 597
Pop. of country:
290,342,554



spurred their players on as they went up against the Koreans.

Last November U.S. baseball officials signed an agreement with China, exchanging coaches, providing equipment for the national team, and developing a baseball program for schools. "We want to put bats and balls in kids' hands around the world," says Paul Archey, in the office of the baseball commissioner—and China is a key part of that strategy.

Archey traces the Asian interest in U.S. major league baseball to 1995, when the Dodgers signed Hideo Nomo, the Japanese pitcher mentioned by manager Lasorda. With more Asian players now in the majors, marketing opportunities are booming in broadcasting, merchandising, licensing, and sponsorships. Every season fans in Japan, where baseball's roots are deepest in Asia, watch games televised from the U.S., often featuring Japanese stars.

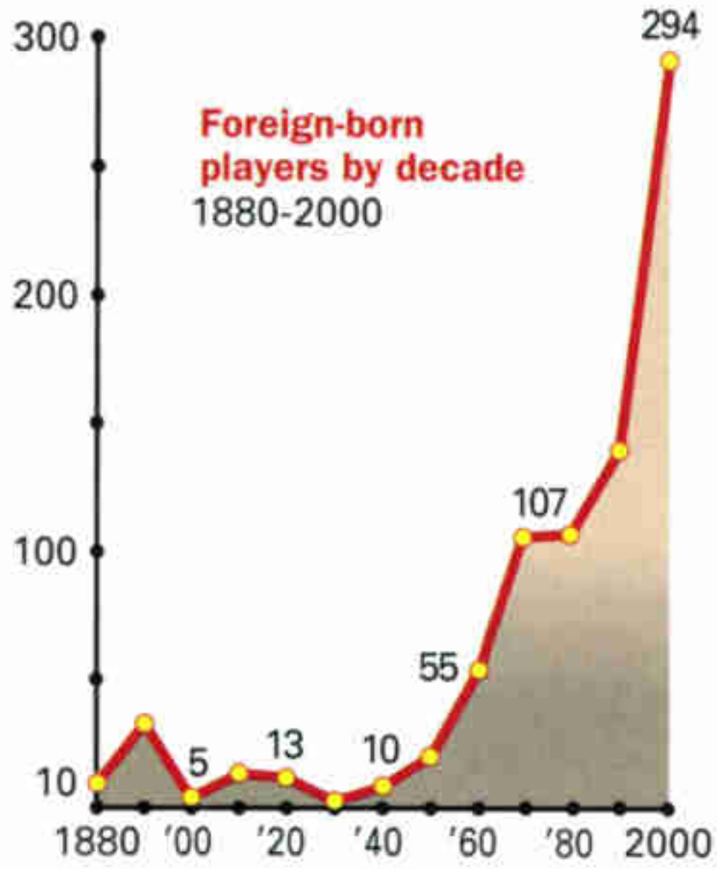
While Asians are relative newcomers to baseball, Latin American players enjoy a long and distinguished history with the game. The Dominican Republic, a seemingly bottomless talent pool, could claim 79 players in the U.S. major leagues on opening day 2003. In a nation where one in four people live below the poverty line, Dominican boys near San Pedro de Macorís—a town famous for spawning players—hone their skills with broken bats (top left), in sandlots that look more like moonscapes (below).

It's a training ground that major league scouts won't soon ignore. But that hasn't stopped baseball from turning its gaze to the East. In 2004, for the second time in the past five years, the major leagues' opening-day game will be played in Tokyo.

—John L. Eliot

From Foreign Shores, They Came to Play

Rooted in stick-and-ball games from the British Isles, the American game of baseball got its major league start in 1876 with the founding of the National League. Players on those first teams, most based in the North, included nine immigrants of English and Irish descent. In the decades to come, only a handful of foreign players—all white—made it to the majors. Though a love of baseball spread to Latin America, prejudice kept the door closed to players of color for the first half of the 20th century.



Then in 1947 Jackie Robinson was signed by the Brooklyn Dodgers, and the door began to open. Roberto Clemente of Puerto Rico, Ozzie Virgil of the Dominican Republic, and a steady stream of others followed. When free agency caused salaries to soar in the late 1970s, teams boosted their efforts to find cheaper talent overseas. Ten years ago the search expanded to Japan, Korea, Taiwan, Australia, and Europe.

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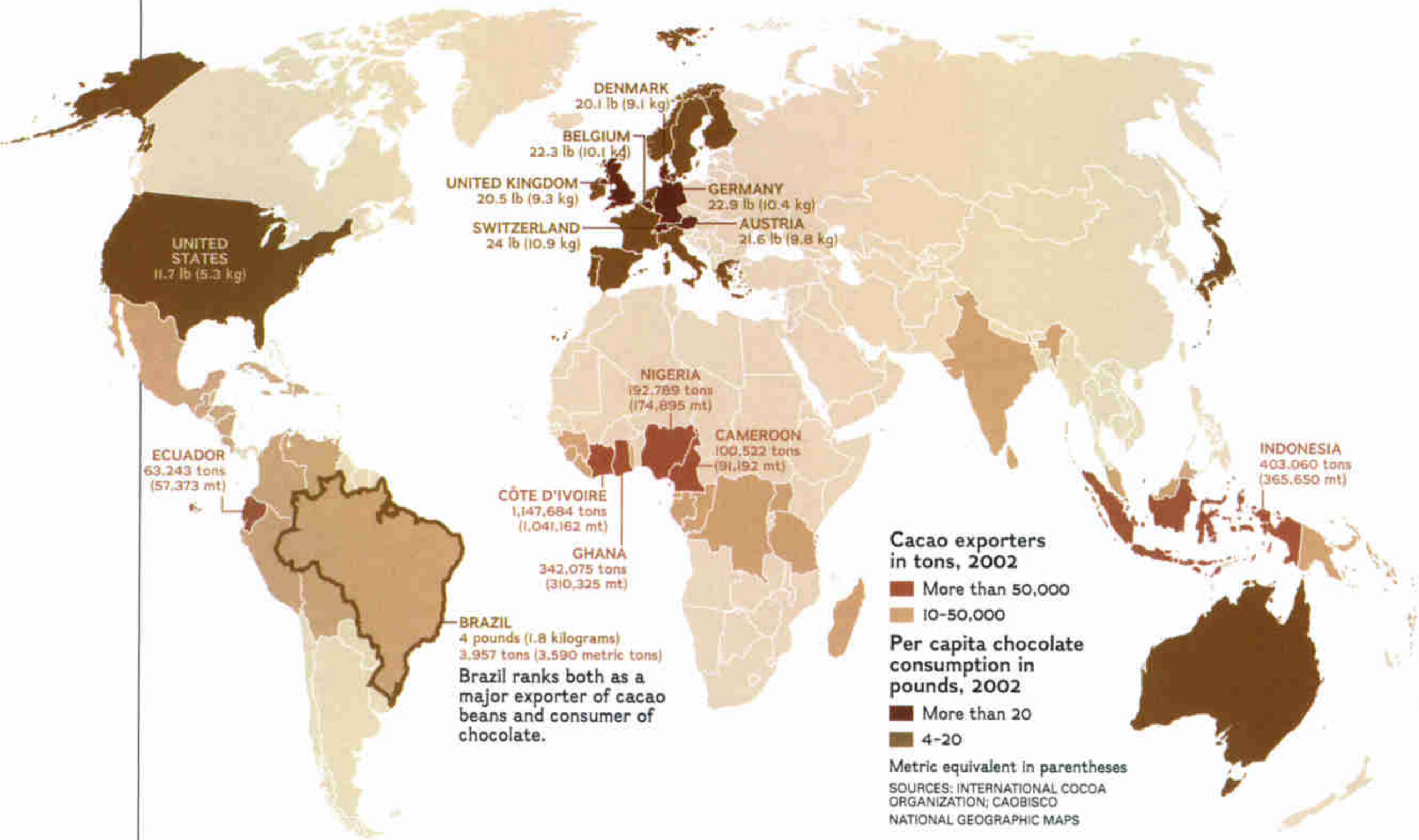
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THE GEOGRAPHY OF EVERYDAY LIFE



One Sweet World: On the Trail of Chocolate



C/B PRODUCTIONS/CORBIS

The cacao tree grows only in the tropics. Yet it's in cooler climes that this plant's beloved product, chocolate, has a voracious following. Europeans lead the pack, with Switzerland, Germany, and Belgium trading off for first place from year to year in per capita chocolate consumption.

Most Europeans take their chocolate in the form of candy. The relatively new concept of selling chocolate in solid form was hatched in London in 1847. Before that, chocolate was for drinking. Probably as early as 1000 B.C., the Olmec were cultivating Central America's native cacao. A thousand years later, the Maya downed shakes of unsweetened chocolate and water. Maya nobles visiting Spain with Dominican friars in 1544 introduced a cocktail of roasted and ground cacao beans, water, wine, and peppers. Sugar was added, and the drink caught on in Europe.

Chocolate's popularity sparked the spread of cacao cultivation. Trees were imported to the Dutch East Indies in 1778 and Africa in 1822. Though Africa now produces two-thirds of the world's cacao beans, Africans themselves consume little chocolate. One reason: meltdown. Cocoa butter, the fat of the cacao bean, liquifies near 90°F, making chocolate melt easily in a 98.6°F mouth—or in a hot climate. Candy needs constant refrigeration if it's in a hot place, and most developing countries can't offer that. Additives for heat-resistance interfere with chocolate's creaminess, so until scientists solve that problem, citizens of cool (or cooled) countries will likely continue as the *champion chocolate eaters.*

—Margaret G. Zackowitz



IF YOU'RE GOING TO RUN OUT OF SOMETHING,

LET IT BE AIR, NOT FILM.

When he was 12 years old, David Doubilet placed a Kodak Brownie Hawkeye camera into a rubber bag and began shooting life underwater off the coast of New Jersey. Today, he is one of the world's leading underwater photographers. David often stalks his photographic prey for hours underwater, painstakingly lighting them under conditions photographers above sea level can't even imagine. It is through David's eyes and brilliant lighting techniques that the monochromatic world beneath the sea has been discovered and colorfully presented to those living so far above its surface.



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NEW YORK

My Seven

Make Your Hotel Room Picture-Perfect

Robert Caputo and Cary Wolinsky *Photographers*

Veterans like Caputo, at left, and Wolinsky, at right, don't pack and carry everything when on assignment. Hotel rooms are loaded with useful photo gear—enough stuff to create a serviceable studio. (Make sure you return everything intact, of course.) In addition to the items on this list, Bob and Cary hid six more accessories in the picture. Can you find them?



1 Luggage rack as photo table To create a tabletop for still-life photography, simply unfold the luggage rack. Place glass on top (borrowed from a desk). Put different colors and textures of cloth underneath to vary background, or crawl under glass to shoot objects from below.



2 Ironing board as equipment table Flat surfaces are at a premium in studios, makeshift or otherwise. The board can be moved near your shooting area, with height adjusted for easy access to lenses, film, and props.

3 Shower curtain as light diffuser To soften harsh light, just carefully detach the shower curtain and place it in front of the light source. If discreetly transported outside, it's good for diffusing direct sunlight, and makes a handy tarp in the event of inclement weather.

4 Bath mat as kneeling pad Photographers spend a lot of time on their knees—begging (sometimes) but mostly just seeking the right angle. In wet or muddy places, a bath mat can be especially useful as a knee and pants preserver.

5 Mirror as light reflector Perfect for bouncing light into a shadowy area to reduce contrast, which will vary with the mirror's distance from the subject. You can also reflect sunlight into a cave, tomb, or other dark area, although direct reflected sunlight is harsh. (Remember to bring that shower curtain.)

6 Shower cap as camera raincoat Rain, snow, and spray are bad for cameras. Wrap a shower cap around the camera body, poke a hole in it for the eyepiece and voilà: instant camera raincoat.

7 Ice bucket as film cooler Good for keeping film cool in hot places, like cars in the summer.

WEBSITE EXCLUSIVE

Did you find the rest of the makeshift photo gear in the picture? For the complete list, go to **nationalgeographic.com/magazine/0404.**



If you skip the  *that bother you*



and take 

and drink 

but your heartburn is still on 

you should know about PREVACID

Ready to do more about your acid reflux disease? Get all the facts and a FREE 7-day trial certificate.

If you suffer from persistent heartburn two or more days a week, even though you've tried diet changes and over-the-counter treatments and that wasn't enough, it may be acid reflux disease. For many people with acid reflux disease, one Prevacid a day can:

- **Help prevent the acid that causes heartburn pain**
- **Relieve heartburn for up to 24 hours**
- **Heal damage to the esophagus**
- **Stop the damage from coming back if prescribed**

Individual results may vary

Prescription Prevacid has a low occurrence of side effects such as diarrhea, abdominal pain, and nausea. Symptom relief does not rule out serious stomach conditions. To learn more, talk to your doctor and see important information on the next page.

Call today to get:

- Your handbook on managing heartburn and acid reflux disease
- Your guide to getting the most out of your next doctor visit
- FREE 7-day trial certificate to use if your doctor prescribes Prevacid



1-800-724-5940

or visit **www.prevacid.com**

PREVACID® LANSOPRAZOLE
HELP PREVENT THE ACID

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Brief Summary of Prescribing Information
(Nos. 1541, 1543, 1544, 3046, 7309, 7311)
03-5316-R22-Brf. Rev. November, 2003

PREVACID®
(lansoprazole)
Delayed-Release Capsules

PREVACID®
(lansoprazole)
For Delayed-Release Oral Suspension

PREVACID® SoluTab™
(lansoprazole)
Delayed-Release Orally Disintegrating Tablets

℞ only

PREVACID Delayed-Release Capsules, PREVACID SoluTab Delayed-Release Orally Disintegrating Tablets and PREVACID For Delayed-Release Oral Suspension are indicated for:

Short-Term Treatment of Active Duodenal Ulcer
***H. pylori* Eradication to Reduce the Risk of Duodenal Ulcer Recurrence**
Triple Therapy: PREVACID/amoxicillin/clarithromycin
Dual Therapy: PREVACID/amoxicillin
Maintenance of Healed Duodenal Ulcers
Short-Term Treatment of Active Benign Gastric Ulcer
Healing of NSAID-Associated Gastric Ulcer
Risk Reduction of NSAID-Associated Gastric Ulcer
Gastroesophageal Reflux Disease (GERD)
Short-Term Treatment of Symptomatic GERD
Short-Term Treatment of Erosive Esophagitis
Maintenance of Healing of Erosive Esophagitis
Pathological Hypersecretory Conditions Including Zollinger-Ellison Syndrome

CONTRAINDICATIONS

PREVACID is contraindicated in patients with known hypersensitivity to any component of the formulation of PREVACID.

Amoxicillin is contraindicated in patients with a known hypersensitivity to any penicillin.

Clarithromycin is contraindicated in patients with a known hypersensitivity to clarithromycin, erythromycin, and any of the macrolide antibiotics.

Concomitant administration of clarithromycin with cisapride, pimozide, astemizole, or terfenadine is contraindicated. There have been post-marketing reports of drug interactions when clarithromycin and/or erythromycin are co-administered with cisapride, pimozide, astemizole, or terfenadine resulting in cardiac arrhythmias (QT prolongation, ventricular tachycardia, ventricular fibrillation, and torsades de pointes) most likely due to inhibition of metabolism of these drugs by erythromycin and clarithromycin. Fatalities have been reported.

(Please refer to full prescribing information for amoxicillin and clarithromycin before prescribing.)

WARNINGS

CLARITHROMYCIN SHOULD NOT BE USED IN PREGNANT WOMEN EXCEPT IN CLINICAL CIRCUMSTANCES WHERE NO ALTERNATIVE THERAPY IS APPROPRIATE. IF PREGNANCY OCCURS WHILE TAKING CLARITHROMYCIN, THE PATIENT SHOULD BE APPRISED OF THE POTENTIAL HAZARD TO THE FETUS. (SEE **WARNINGS** IN PRESCRIBING INFORMATION FOR CLARITHROMYCIN.)

Pseudomembranous colitis has been reported with nearly all antibacterial agents, including clarithromycin and amoxicillin, and may range in severity from mild to life threatening. Therefore, it is important to consider this diagnosis in patients who present with diarrhea subsequent to the administration of antibacterial agents.

Treatment with antibacterial agents alters the normal flora of the colon and may permit overgrowth of clostridia. Studies indicate that a toxin produced by *Clostridium difficile* is a primary cause of "antibiotic-associated colitis."

After the diagnosis of pseudomembranous colitis has been established, therapeutic measures should be initiated. Mild cases of pseudomembranous colitis usually respond to discontinuation of the drug alone. In moderate to severe cases, consideration should be given to management with fluids and electrolytes, protein supplementation, and treatment with an antibacterial drug clinically effective against *Clostridium difficile* colitis.

Serious and occasionally fatal hypersensitivity (anaphylactic) reactions have been reported in patients on penicillin therapy. These reactions are more apt to occur in individuals with a history of penicillin hypersensitivity and/or a history of sensitivity to multiple allergens.

There have been well-documented reports of individuals with a history of penicillin hypersensitivity reactions who have experienced severe hypersensitivity reactions when treated with a cephalosporin. Before initiating therapy with any penicillin, careful inquiry should be made concerning previous hypersensitivity reactions to penicillins, cephalosporins, and other allergens. If an allergic reaction occurs, amoxicillin should be discontinued and the appropriate therapy instituted.

SERIOUS ANAPHYLACTIC REACTIONS REQUIRE IMMEDIATE EMERGENCY TREATMENT WITH EPINEPHRINE. OXYGEN, INTRAVENOUS STEROIDS, AND AIRWAY MANAGEMENT, INCLUDING INTUBATION, SHOULD ALSO BE ADMINISTERED AS INDICATED.

PRECAUTIONS

General

Symptomatic response to therapy with lansoprazole does not preclude the presence of gastric malignancy.

Information for Patients

PREVACID is available as a capsule, orally disintegrating tablet and oral suspension, and is available in 15 mg and 30 mg strengths. Directions for use specific to the route and available methods of administration for each of these dosage forms is presented below. PREVACID should be taken before eating. PREVACID products SHOULD NOT BE CRUSHED OR CHEWED.

Phenylketonurics: Contains Phenylalanine 2.5 mg per 15 mg Tablet and 5.1 mg per 30 mg Tablet.

Administration Options

1. PREVACID Delayed-Release Capsules

PREVACID Delayed-Release Capsules should be swallowed whole.

Alternatively, for patients who have difficulty swallowing capsules, PREVACID Delayed-Release Capsules can be opened and administered as follows:

- Open capsule.
- Sprinkle intact granules on one tablespoon of either applesauce, ENSURE® pudding, cottage cheese, yogurt or strained pears.
- Swallow immediately.

PREVACID Delayed-Release Capsules may also be emptied into a small volume of either apple juice, orange juice or tomato juice and administered as follows:

- Open capsule.
- Sprinkle intact granules into a small volume of either apple juice, orange juice or tomato juice (60 mL – approximately 2 ounces).
- Mix briefly.
- Swallow immediately.
- To insure complete delivery of the dose, the glass should be rinsed with two or more volumes of juice and the contents swallowed immediately.

USE IN OTHER FOODS AND LIQUIDS HAS NOT BEEN STUDIED CLINICALLY AND IS THEREFORE NOT RECOMMENDED.

2. PREVACID SoluTab Delayed-Release Orally Disintegrating Tablets

PREVACID SoluTabs are not designed to be swallowed intact or chewed. The tablet typically disintegrates in less than 1 minute.

- Place the tablet on the tongue.
- Allow it to disintegrate with or without water until the particles can be swallowed.

3. PREVACID for Delayed-Release Oral Suspension

PREVACID for Delayed-Release Oral Suspension should be administered as follows:

- Open packet.
- To prepare a dose, empty the packet contents into a container containing 2 tablespoons of **WATER**. DO NOT USE OTHER LIQUIDS OR FOODS.
- Stir well, and drink immediately.
- If any material remains after drinking, add more water, stir, and drink immediately.
- **This product should not be given through enteral administration tubes.**

Drug Interactions

Lansoprazole is metabolized through the cytochrome P_{450} system, specifically through the CYP3A and CYP2C19 isozymes. Studies have shown that lansoprazole does not have clinically significant interactions with other drugs metabolized by the cytochrome P_{450} system, such as warfarin, antipyrine, indomethacin, ibuprofen, phenytoin, propranolol, prednisone, diazepam, or clarithromycin in healthy subjects. These compounds are metabolized through various cytochrome P_{450} isozymes including CYP1A2, CYP2C9, CYP2C19, CYP2D6, and CYP3A. When lansoprazole was administered concomitantly with theophylline (CYP1A2, CYP3A), a minor increase (10%) in the clearance of theophylline was seen. Because of the small magnitude and the direction of the effect on theophylline clearance, this interaction is unlikely to be of clinical concern. Nonetheless, individual patients may require additional titration of their theophylline dosage when lansoprazole is started or stopped to ensure clinically effective blood levels.

In a study of healthy subjects neither the pharmacokinetics of warfarin enantiomers nor prothrombin time were affected following single or multiple 60 mg doses of lansoprazole. However, there have been reports of increased International Normalized Ratio (INR) and prothrombin time in patients receiving proton pump inhibitors, including lansoprazole, and warfarin concomitantly. Increases in INR and prothrombin time may lead to abnormal bleeding and even death. Patients treated with proton pump inhibitors and warfarin concomitantly may need to be monitored for increases in INR and prothrombin time.

Lansoprazole has also been shown to have no clinically significant interaction with amoxicillin.

In a single-dose crossover study examining lansoprazole 30 mg and omeprazole 20 mg each administered alone and concomitantly with sucralfate 1 gram, absorption of the proton pump inhibitors was delayed and their bioavailability was reduced by 17% and 16%, respectively, when administered concomitantly with sucralfate. Therefore, proton pump inhibitors should be taken at least 30 minutes prior to sucralfate. In clinical trials, antacids were administered concomitantly with PREVACID Delayed-Release Capsules; this did not interfere with its effect.

Lansoprazole causes a profound and long-lasting inhibition of gastric acid secretion; therefore, it is theoretically possible that lansoprazole may interfere with the absorption of drugs where gastric pH is an important determinant of bioavailability (e.g., ketoconazole, ampicillin esters, iron salts, digoxin).

Carcinogenesis, Mutagenesis, Impairment of Fertility

In two 24-month carcinogenicity studies, Sprague-Dawley rats were treated orally with doses of 5 to 150 mg/kg/day, about 1 to 40 times the exposure on a body surface (mg/m^2) basis, of a 50-kg person of average height (1.46 m^2 body surface area) given the recommended human dose of 30 mg/day (22.2 mg/m^2). Lansoprazole produced dose-related gastric enterochromaffin-like (ECL) cell hyperplasia and ECL cell carcinoids in both male and female rats. It also increased the incidence of intestinal metaplasia of the gastric epithelium in both sexes. In male rats, lansoprazole produced a dose-related increase of testicular interstitial cell adenomas. The incidence of these adenomas in rats receiving doses of 15 to 150 mg/kg/day (4 to 40 times the recommended human dose based on body surface area) exceeded the low background incidence (range = 1.4 to 10%) for this strain of rat. Testicular interstitial cell adenoma also occurred in 1 of 30 rats treated with 50 mg/kg/day (13 times the recommended human dose based on body surface area) in a 1-year toxicity study.

In a 24-month carcinogenicity study, CD-1 mice were treated orally with doses of 15 to 600 mg/kg/day, 2 to 80 times the recommended human dose based on body surface area. Lansoprazole produced a dose-related increased incidence of gastric ECL cell hyperplasia. It also produced an increased incidence of liver tumors (hepatocellular adenoma plus carcinoma). The tumor incidences in male mice treated with 300 and 600 mg/kg/day (40 to 80 times the recommended human dose based on body surface area) and female mice treated with 150 to 600 mg/kg/day (20 to 80 times the recommended human dose based on body surface area) exceeded the ranges of background incidences in historical controls for this strain of mice. Lansoprazole treatment produced adenoma of rete testis in male mice receiving 75 to 600 mg/kg/day (10 to 80 times the recommended human dose based on body surface area).

Lansoprazole was not genotoxic in the Ames test, the *ex vivo* rat hepatocyte unscheduled DNA synthesis (UDS) test, the *in vivo* mouse micronucleus test or the rat bone marrow cell chromosomal aberration test. It was positive in *in vitro* human lymphocyte chromosomal aberration assays.

Lansoprazole at oral doses up to 150 mg/kg/day (40 times the recommended human dose based on body surface area) was found to have no effect on fertility and reproductive performance of male and female rats.

Pregnancy: Teratogenic Effects.

Pregnancy Category B

Lansoprazole

Teratology studies have been performed in pregnant rats at oral doses up to

150 mg/kg/day (40 times the recommended human dose based on body surface area) and pregnant rabbits at oral doses up to 30 mg/kg/day (16 times the recommended human dose based on body surface area) and have revealed no evidence of impaired fertility or harm to the fetus due to lansoprazole.

There are, however, no adequate or well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed.

Pregnancy Category C

Clarithromycin

See **WARNINGS** (above) and full prescribing information for clarithromycin before using in pregnant women.

Nursing Mothers

Lansoprazole or its metabolites are excreted in the milk of rats. It is not known whether lansoprazole is excreted in human milk. Because many drugs are excreted in human milk, because of the potential for serious adverse reactions in nursing infants from lansoprazole, and because of the potential for tumorigenicity shown for lansoprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother.

Pediatric Use

The safety and effectiveness of PREVACID have been established in the age group 1 year to 11 years for short-term treatment of symptomatic GERD and erosive esophagitis. Safety and effectiveness have not been established in patients < 1 year or 12-17 years of age.

Use of PREVACID in the age group 1 year to 11 years is supported by evidence from adequate and well controlled studies of PREVACID in adults with additional clinical, pharmacokinetic, pharmacodynamic, and safety studies performed in pediatric patients.

The pediatric safety of PREVACID Delayed-Release Capsules has been assessed in 66 pediatric patients aged 1 to 11 years of age. Of the 66 patients with GERD 85% (56/66) took lansoprazole for 8 weeks and 15% (10/66) took it for 12 weeks.

The adverse event profile in these pediatric patients resembled that of adults taking lansoprazole. The most frequently reported (2 or more patients) treatment-related adverse events in patients 1 to 11 years of age (N=66) were constipation (5%) and headache (3%). There were no adverse events reported in this U.S. clinical study that were not previously observed in adults.

Use in Women

Over 4,000 women were treated with lansoprazole. Ulcer healing rates in females were similar to those in males. The incidence rates of adverse events were also similar to those seen in males.

Use in Geriatric Patients

Ulcer healing rates in elderly patients are similar to those in a younger age group. The incidence rates of adverse events and laboratory test abnormalities are also similar to those seen in younger patients. For elderly patients, dosage and administration of lansoprazole need not be altered for a particular indication.

ADVERSE REACTIONS

Clinical

Worldwide, over 10,000 patients have been treated with lansoprazole in Phase 2-3 clinical trials involving various dosages and durations of treatment. The adverse reaction profiles for PREVACID Delayed-Release Capsules and PREVACID for Delayed-Release Oral Suspension are similar. In general, lansoprazole treatment has been well-tolerated in both short-term and long-term trials.

The following adverse events were reported by the treating physician to have a possible or probable relationship to drug in 1% or more of PREVACID-treated patients and occurred at a greater rate in PREVACID-treated patients than placebo-treated patients:

Incidence of Possibly or Probably Treatment-Related Adverse Events in Short-Term, Placebo-Controlled Studies

Body System/Adverse Event	PREVACID (N= 2768) %	Placebo (N= 1023) %
Body as a Whole		
Abdominal Pain	2.1	1.2
Digestive System		
Constipation	1.0	0.4
Diarrhea	3.8	2.3
Nausea	1.3	1.2

Headache was also seen at greater than 1% incidence but was more common on placebo. The incidence of diarrhea was similar between patients who received placebo and patients who received lansoprazole 15 mg and 30 mg, but higher in the patients who received lansoprazole 60 mg (2.9%, 1.4%, 4.2%, and 7.4%, respectively).

The most commonly reported possibly or probably treatment-related adverse event during maintenance therapy was diarrhea.

In the risk reduction study of PREVACID for NSAID-associated gastric ulcers, the incidence of diarrhea for patients treated with PREVACID was 5%, misoprostol 22%, and placebo 3%.

Additional adverse experiences occurring in <1% of patients or subjects in domestic trials are shown below. Refer to **Postmarketing** for adverse reactions occurring since the drug was marketed.

Body as a Whole – abdomen enlarged, allergic reaction, asthenia, back pain, candidiasis, carcinoma, chest pain (not otherwise specified), chills, edema, fever, flu syndrome, halitosis, infection (not otherwise specified), malaise, neck pain, neck rigidity, pain, pelvic pain; *Cardiovascular System* - angina, arrhythmia, bradycardia, cerebrovascular accident/cerebral infarction, hypertension/hypotension, migraine, myocardial infarction, palpitations, shock (circulatory failure), syncope, tachycardia, vasodilation; *Digestive System* – abnormal stools, anorexia, bezoar, cardiospasm, cholelithiasis, colitis, dry mouth, dyspepsia, dysphagia, enteritis, eructation, esophageal stenosis, esophageal ulcer, esophagitis, fecal discoloration, flatulence, gastric nodules/fundic gland polyps, gastritis, gastroenteritis, gastrointestinal anomaly, gastrointestinal disorder, gastrointestinal hemorrhage, glossitis, gum hemorrhage, hematemesis, increased appetite, increased salivation, melena, mouth ulceration, nausea and vomiting, nausea and vomiting and diarrhea, oral moniliasis, rectal disorder, rectal hemorrhage, stomatitis, tenesmus, thirst, tongue disorder, ulcerative colitis, ulcerative stomatitis; *Endocrine System* - diabetes mellitus, goiter, hypothyroidism; *Hemic and Lymphatic System* - anemia, hemolysis, lymphadenopathy; *Metabolic and Nutritional Disorders* - gout, dehydration, hyperglycemia/hypoglycemia, peripheral edema, weight gain/loss; *Musculoskeletal System* - arthralgia, arthritis, bone disorder, joint disorder, leg cramps, musculoskeletal pain, myalgia, myasthenia, synovitis; *Nervous System* – abnormal dreams, agitation, amnesia, anxiety, apathy, confusion, convulsion, depersonalization, depression, diplopia, dizziness, emotional lability, hallucinations, hemiplegia, hostility aggravated, hyperkinesia, hypertonia, hypesthesia, insomnia, libido decreased/increased, nervousness, neurosis, paresthesia, sleep disorder, somnolence, thinking abnormality, tremor, vertigo; *Respiratory System* - asthma, bronchitis, cough increased, dyspnea, epistaxis, hemoptysis, hiccup, laryngeal neoplasia, pharyngitis, pleural disorder, pneumonia, respiratory disorder, upper respiratory inflammation/infection, rhinitis, sinusitis, stridor; *Skin and Appendages* - acne, alopecia, contact dermatitis, dry skin, fixed eruption, hair disorder, maculopapular rash, nail disorder, pruritus, rash, skin carcinoma, skin disorder, sweating, urticaria; *Special Senses* – abnormal vision, blurred vision, conjunctivitis, deafness, dry eyes, ear disorder, eye pain, otitis media, parosmia, photophobia, retinal degeneration, taste loss, taste perversion, tinnitus, visual field defect; *Urogenital System* - abnormal menses, breast enlargement, breast pain, breast tenderness, dysmenorrhea, dysuria, gynecomastia, impotence, kidney calculus, kidney pain, leukorrhea, menorrhagia, menstrual disorder, penis disorder, polyuria, testis disorder, urethral pain, urinary frequency, urinary tract infection, urinary urgency, urination impaired, vaginitis.

Postmarketing

On-going Safety Surveillance: Additional adverse experiences have been reported since lansoprazole has been marketed. The majority of these cases are foreign-sourced and a relationship to lansoprazole has not been established. Because these events were reported voluntarily from a population of unknown size, estimates of frequency cannot be made. These events are listed below by COSTART body system.

Body as a Whole - anaphylactoid-like reaction; *Digestive System* - hepatotoxicity, pancreatitis, vomiting; *Hemic and Lymphatic System* - agranulocytosis, aplastic anemia, hemolytic anemia, leukopenia, neutropenia, pancytopenia, thrombocytopenia, and thrombotic thrombocytopenic purpura; *Skin and Appendages* – severe dermatologic reactions including erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis (some fatal); *Special Senses* - speech disorder; *Urogenital System* - urinary retention.

Combination Therapy with Amoxicillin and Clarithromycin

In clinical trials using combination therapy with PREVACID plus amoxicillin and clarithromycin, and PREVACID plus amoxicillin, no adverse reactions peculiar to these drug combinations were observed. Adverse reactions that have occurred have been limited to those that had been previously reported with PREVACID, amoxicillin, or clarithromycin.

Triple Therapy: PREVACID/amoxicillin/clarithromycin

The most frequently reported adverse events for patients who received triple therapy for 14 days were diarrhea (7%), headache (6%), and taste perversion (5%). There were no statistically significant differences in the frequency of reported adverse events between the 10- and 14-day triple therapy regimens. No treatment-emergent adverse events were observed at significantly higher rates with triple therapy than with any dual therapy regimen.

Dual Therapy: PREVACID/amoxicillin

The most frequently reported adverse events for patients who received PREVACID t.i.d. plus amoxicillin t.i.d. dual therapy were diarrhea (8%) and headache (7%). No treatment-emergent adverse events were observed at significantly higher rates with PREVACID t.i.d. plus amoxicillin t.i.d. dual therapy than with PREVACID alone.

For more information on adverse reactions with amoxicillin or clarithromycin, refer to their package inserts, **ADVERSE REACTIONS** sections.

Laboratory Values

The following changes in laboratory parameters for lansoprazole were reported as adverse events:

Abnormal liver function tests, increased SGOT (AST), increased SGPT (ALT), increased creatinine, increased alkaline phosphatase, increased globulins, increased GGTP, increased/decreased/abnormal WBC, abnormal AG ratio, abnormal RBC, bilirubinemia, eosinophilia, hyperlipemia, increased/decreased electrolytes, increased/decreased cholesterol, increased glucocorticoids, increased LDH, increased/decreased/abnormal platelets, and increased gastrin levels. Urine abnormalities such as albuminuria, glycosuria, and hematuria were also reported. Additional isolated laboratory abnormalities were reported.

In the placebo controlled studies, when SGOT (AST) and SGPT (ALT) were evaluated, 0.4% (4/978) placebo patients and 0.4% (11/2677) lansoprazole patients had enzyme elevations greater than three times the upper limit of normal range at the final treatment visit. None of these lansoprazole patients reported jaundice at any time during the study.

In clinical trials using combination therapy with PREVACID plus amoxicillin and clarithromycin, and PREVACID plus amoxicillin, no increased laboratory abnormalities particular to these drug combinations were observed.

For more information on laboratory value changes with amoxicillin or clarithromycin, refer to their package inserts, **ADVERSE REACTIONS** section.

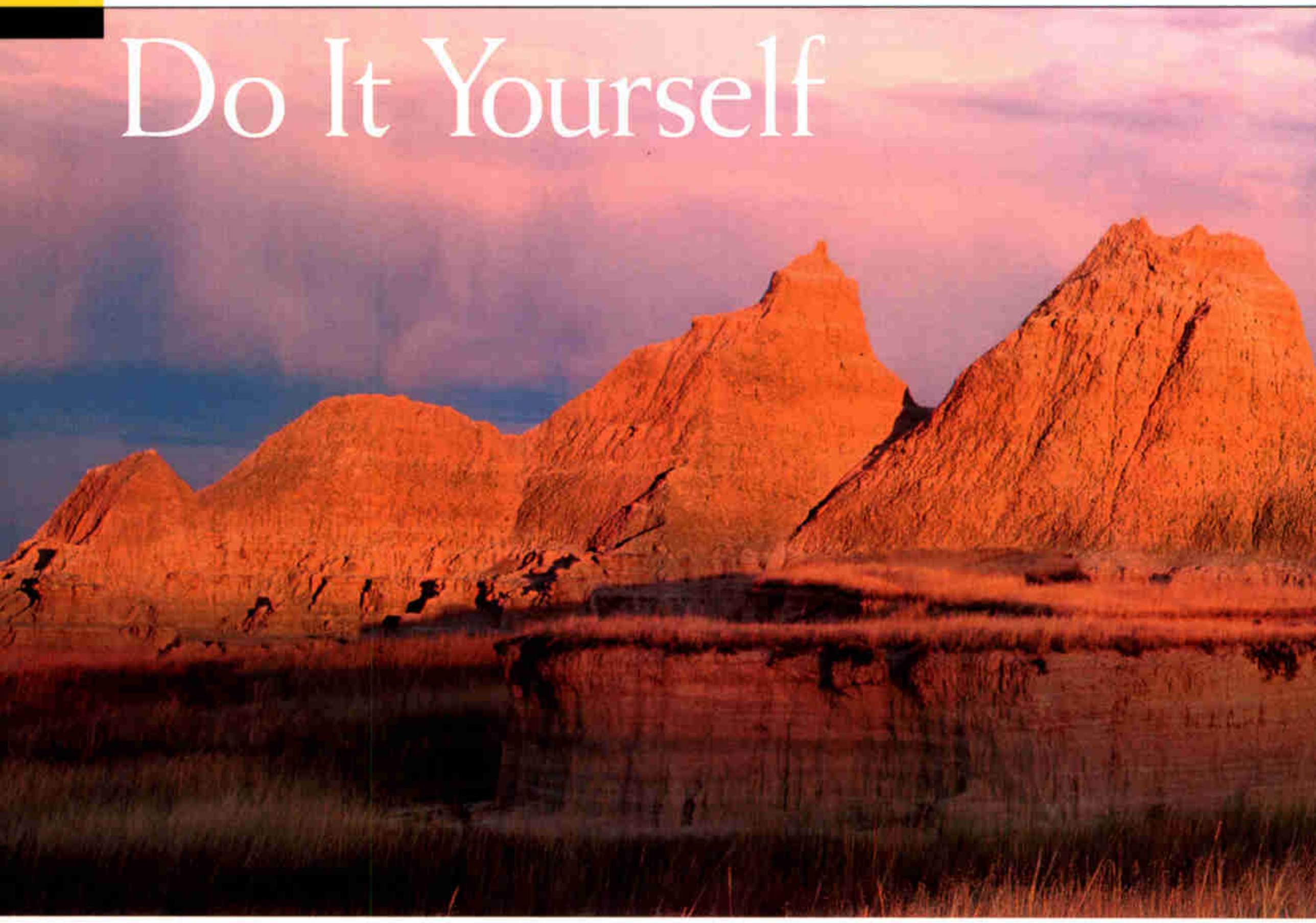
OVERDOSAGE

Oral doses up to 5000 mg/kg in rats (approximately 1300 times the recommended human dose based on body surface area) and mice (about 675.7 times the recommended human dose based on body surface area) did not produce deaths or any clinical signs.

Lansoprazole is not removed from the circulation by hemodialysis. In one reported case of overdose, the patient consumed 600 mg of lansoprazole with no adverse reaction.

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MR030-0094

Do It Yourself

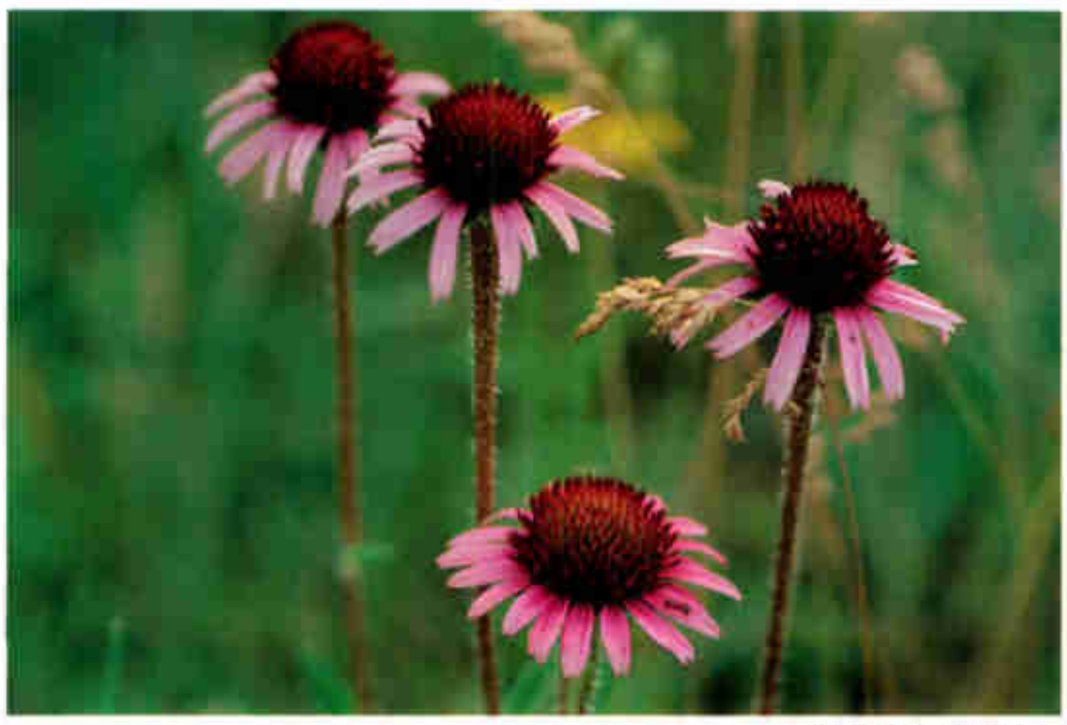


BADLANDS (SEE PAGE 78)

TRY IT AT HOME

A Piece of the Prairie in Your Backyard

About 400 million acres of grassland cloaked the center of North America before European settlers arrived. Perhaps one percent of the original prairie escaped the plow. Now more and more people are bringing the prairie back home. "We bought a third of an acre for our house, planted it with native plants in 1983, and now have 200 prairie species," says Pat Armstrong, a landscaping consultant who lives 20 miles west of Chicago. She has a blaze of wildflowers that attracts birds and other wildlife, and no need for pesticides or watering. You can grow grassland species like purple coneflowers (*Echinacea angustifolia*, left) wherever prairies once thrived, from southern Canada to Texas, and east of the Rockies to the Appalachians—and even beyond. Check with your local plant society to see what's appropriate for your area. To learn more, go to *for-wild.org* or *wildflower2.org*.



ANNIE GRIFFITHS BELT

PICKS

3 hikes

Author **John Eliot** suggests these Badlands hikes on maintained trails as well as in the backcountry:

- **Notch Trail** Not recommended for acrophobes: Be prepared to climb a tall ladder to a ledge atop a canyon.
- **Fossil Exhibit Trail** A short boardwalk hike, with occasional lectures by a park guide, this loop displays mammal fossils under plastic domes.
- **Badlands Wilderness** Follow buffalo trails through low hills and rolling meadows.

CARR CLIFTON, MINDEN PICTURES; AMERICAN PHILOSOPHICAL SOCIETY (BELOW)



EDWARD CURTIS

GO THERE

Sheep Mountain: A Sacred Place

Ringed by canyons and jagged pinnacles, Sheep Mountain Table, in Badlands National Park's less developed South Unit, offers a ringside seat to the drama of the Badlands and an opportunity to get away from summer traffic on park loop roads.

Rising 3,282 feet, Sheep Mountain covers 1,200 acres, one of the area's largest sod tables —flat grassy areas isolated by ancient streams that carved claystone steeply around them. Though within the boundaries of the national park (above), parts of the table belong to the Pine Ridge Indian Reservation, owned by the Oglala Sioux. (Edward Curtis photographed Teton Sioux on the table in 1904, left.) Although most Oglala Sioux now live south of the park, they still perform religious rituals on the table, tying prayer flags and offerings of tobacco to plants, which visitors should not disturb.

One warning: The seven-mile unmaintained dirt road to the top of the table is passable only when dry.

Echoes of the Sioux Ghost Dance

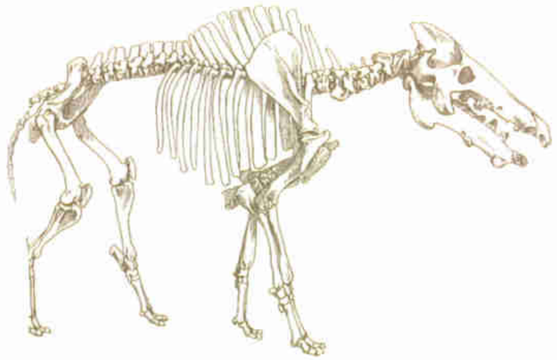
On another sod table—Stronghold—the Sioux performed one of the last Ghost Dances, in 1890. The ritual, the Sioux believed, would bring the return of their lands, buffalo, and dead relatives; special shirts would repel the bullets of the U.S. Army. Later that year over 200 Sioux died in the Wounded Knee massacre south of what is now the park.

WEBSITE EXCLUSIVE

Get the goods on the Badlands—the who, what, when, and how of traveling there—at **nationalgeographic.com/magazine/0404**.

GET INVOLVED

The Big Pig Dig



Hornless rhinos, miniature horses, tiny deer—a lost world underlies the Badlands. Paleontologists stampeded here in the 1850s after the discovery of a vast bed of mammal fossils. Today about 10,000 people a year visit a site called the Big Pig Dig (after *Archaeotherium,* left, a piglike mammal found there). But you can't touch any of the site's 33-million-year-old fossils unless you have a permit or join a two-week collecting expedition run by the Museum of Geology at the South Dakota School of Mines and Technology in July. At *museum.sdsmt.edu,* find out how to sign up for one of the few slots available to the public.

GET MORE FROM THE SOCIETY

To learn more about a subject covered in this issue, try these National Geographic Society products and services. Call 1-888-225-5647 or log on to nationalgeographic.com for more information.

NATIONAL GEOGRAPHIC

- **Badlands National Park Trails Illustrated Map.** A tear-resistant waterproof topographic map to help you find your way in the Badlands. Comes with wilderness regulations and safety tips. Other South Dakota maps also available ($9.95).
- ***Guide to the National Parks of the United States*** book. Learn more about Badlands and other parks. Updated; includes suggestions for regional day trips ($24.95).
- **The Complete TrailSmart Maps: National Parks of the USA.** Print your own customized topographic maps of trails—with elevation statistics—in Badlands and other U.S. national parks with this five CD-ROM set. Works with GPS ($49.95).





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With HP digital cameras and printers, you are the photographer and the photo lab. And you can make sure your digital photos last for years to come. Because photos printed with genuine HP inks and papers resist fading for generations: So even as your memories of Yosemite and Yellowstone grow hazy, your photos won't.

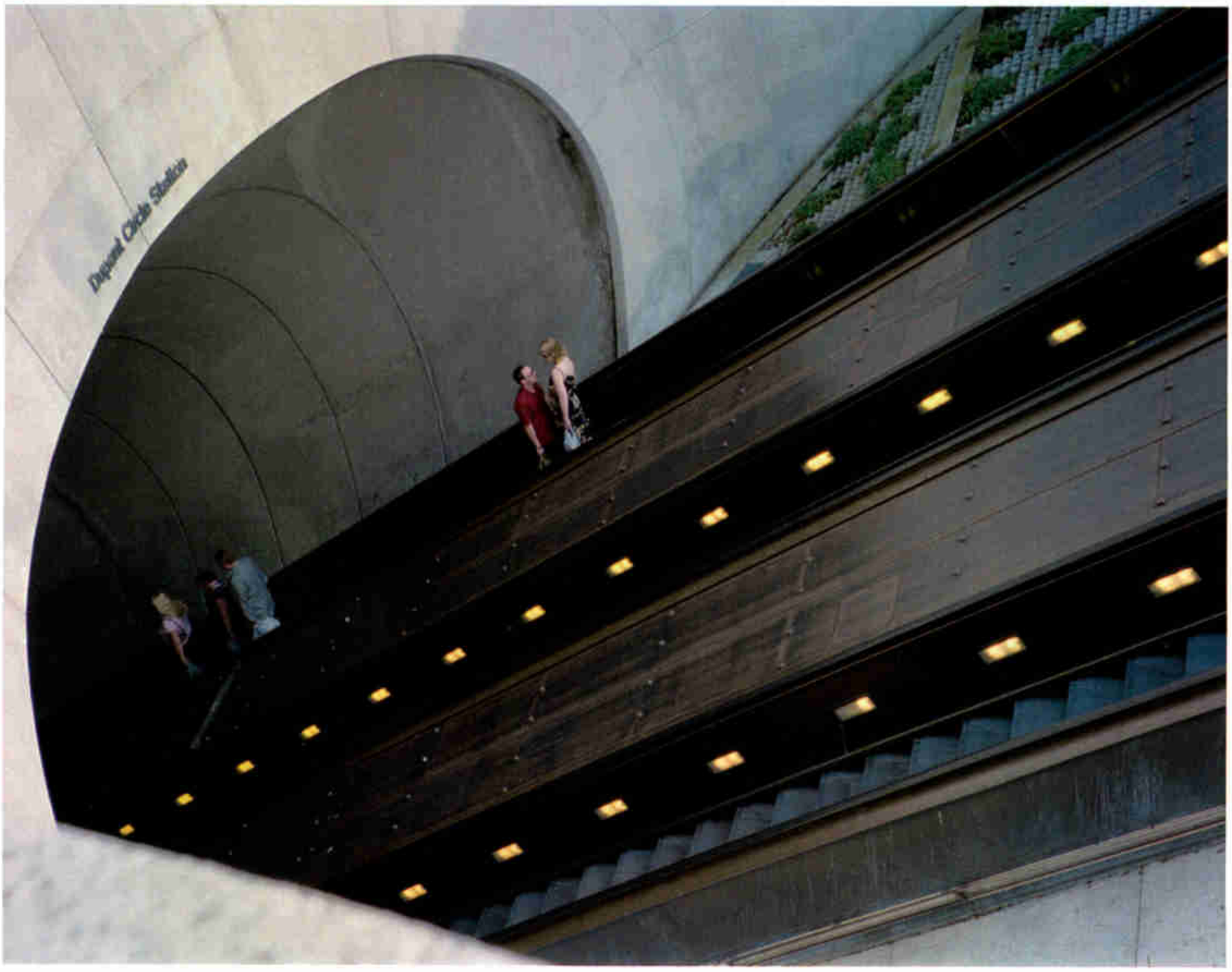
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*Based on Wilhelm Imaging Research, Inc., using the HP 58 photo inkjet print cartridge on HP Premium Plus photo papers.

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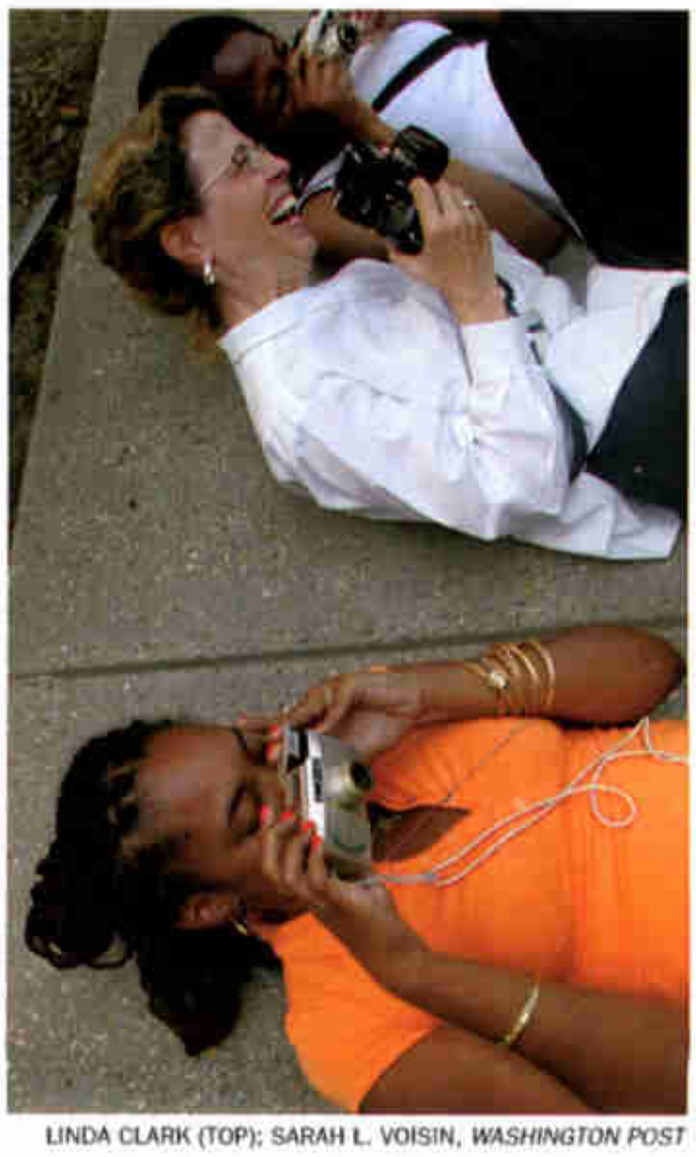


School for Shutterbugs

NG interns hit the streets

They didn't travel to far-flung lands, but National Geographic's first group of Photo Camp students did tackle a concrete topic for their assignment: creating images for a ZipUSA-style magazine story on downtown Washington, D.C.

Recommended by their guidance counselors to be summer interns at Society headquarters, the 13 D.C. high schoolers worked in various departments but spent Wednesdays at Photo Camp, learning the picture-taking craft from experts—NG contributing photographers-in-residence. "I tried to teach creative thinking," says Annie Griffiths Belt (left, at middle), one of the photographers who worked with the interns and critiqued their photos. "I showed them how to find a new angle, to not be afraid to climb or get down low." Or look down, as in a shot of the precipitous angle of a subway escalator (above). Said one student of the experience, "It's like learning golf from Tiger Woods."



LINDA CLARK (TOP); SARAH L. VOISIN, *WASHINGTON POST*



SINGULAIR IS THE ONLY SEASONAL ALLERGY MEDICATION THAT SPECIFICALLY BLOCKS *LEUKOTRIENES*. Many existing allergy medicines block histamine. SINGULAIR is different. It works by blocking leukotrienes (loo-koh-TRY-eens). Leukotrienes are an underlying cause of allergy symptoms. They are substances produced in your body that can make you feel uncomfortable during allergy season.

HELPS RELIEVE A BROAD RANGE OF SYMPTOMS. A single SINGULAIR tablet a day helps relieve a broad range of seasonal allergy symptoms for a full 24 hours. SINGULAIR is also available in a cherry chewable tablet for children 2 to 14 years of age. In clinical studies, SINGULAIR was not associated with drowsiness. SINGULAIR should be taken once a day, as prescribed. SINGULAIR is available by prescription only.

IMPORTANT INFORMATION: In clinical studies, side effects were usually mild and varied by age, and included headache, ear infection, sore throat, and upper respiratory infection. Side effects generally did not stop patients from taking SINGULAIR. SINGULAIR should not be taken by people who are sensitive to any of its ingredients.

Ask your doctor about SINGULAIR for your seasonal allergies.
Call 1-888-MERCK-95, or visit singulair.com.

Please see the Patient Product Information on the adjacent page and discuss it with your doctor.

MERCK patient assistance program

This product is available through the Merck Patient Assistance Program. To find out if you qualify call 1-888-MERCK-56.

ONCE-A-DAY
SINGULAIR®
(MONTELUKAST SODIUM)
A different way to treat seasonal allergies.

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Patient Information
SINGULAIR® (SING-u-lair) Tablets, Chewable Tablets, and Oral Granules
Generic name: montelukast (mon-te-LOO-kast) sodium

Read this information before you start taking SINGULAIR®. Also, read the leaflet you get each time you refill SINGULAIR, since there may be new information in the leaflet since the last time you saw it. This leaflet does not take the place of talking with your doctor about your medical condition and/or your treatment.

What is SINGULAIR®?

- SINGULAIR is a medicine called a leukotriene receptor antagonist. It works by blocking substances in the body called leukotrienes. Blocking leukotrienes improves asthma and seasonal allergic rhinitis (also known as hay fever). SINGULAIR is not a steroid.

SINGULAIR is prescribed for the treatment of asthma and seasonal allergic rhinitis:

1. **Asthma.**
 SINGULAIR should be used for the long-term management of asthma in adults and children ages 12 months and older.

 Do not take SINGULAIR for the immediate relief of an asthma attack. If you get an asthma attack, you should follow the instructions your doctor gave you for treating asthma attacks. (See the end of this leaflet for more information about asthma.)

2. **Seasonal Allergic Rhinitis.**
 SINGULAIR is used to help control the symptoms of seasonal allergic rhinitis (sneezing, stuffy nose, runny nose, itching of the nose) in adults and children ages 2 years and older. (See the end of this leaflet for more information about seasonal allergic rhinitis.)

Who should not take SINGULAIR?

Do not take SINGULAIR if you are allergic to SINGULAIR or any of its ingredients.

The active ingredient in SINGULAIR is montelukast sodium.

See the end of this leaflet for a list of all the ingredients in SINGULAIR.

What should I tell my doctor before I start taking SINGULAIR?

Tell your doctor about:
- **Pregnancy**: If you are pregnant or plan to become pregnant, SINGULAIR may not be right for you.
- **Breast-feeding**: If you are breast-feeding, SINGULAIR may be passed in your milk to your baby. You should consult your doctor before taking SINGULAIR if you are breast-feeding or intend to breast-feed.
- **Medical Problems or Allergies**: Talk about any medical problems or allergies you have now or had in the past.
- **Other Medicines**: Tell your doctor about all the medicines you take, including prescription and non-prescription medicines, and herbal supplements. Some medicines may affect how SINGULAIR works, or SINGULAIR may affect how your other medicines work.

How should I take SINGULAIR?

For adults or children 12 months of age and older with asthma:
- Take SINGULAIR once a day in the evening.
- Take SINGULAIR every day for as long as your doctor prescribes it, even if you have no asthma symptoms.
- You may take SINGULAIR with food or without food.
- If your asthma symptoms get worse, or if you need to increase the use of your inhaled rescue medicine for asthma attacks, call your doctor right away.
- **Do not take SINGULAIR for the immediate relief of an asthma attack.** If you get an asthma attack, you should follow the instructions your doctor gave you for treating asthma attacks.
- Always have your inhaled rescue medicine for asthma attacks with you.
- Do not stop taking or lower the dose of your other asthma medicines unless your doctor tells you to.
- If your doctor has prescribed a medicine for you to use before exercise, keep using that medicine unless your doctor tells you not to.

For adults and children 2 years of age and older with seasonal allergic rhinitis:
- Take SINGULAIR once a day, at about the same time each day.
- Take SINGULAIR every day for as long as your doctor prescribes it.
- You may take SINGULAIR with food or without food.

How should I give SINGULAIR oral granules to my child?

Do not open the packet until ready to use.

SINGULAIR 4-mg oral granules can be given either:
- directly in the mouth; OR
- mixed with a spoonful of one of the following soft foods at cold or room temperature: applesauce, mashed carrots, rice, or ice cream. Be sure that the entire dose is mixed with the food and that the child is given the entire spoonful of the mixture right away (within 15 minutes).

IMPORTANT: Never store any oral granule/food mixture for use at a later time. Throw away any unused portion.

Do not put SINGULAIR oral granules in liquid drink. However, your child may drink liquids after swallowing the SINGULAIR oral granules.

What is the daily dose of SINGULAIR for asthma or seasonal allergic rhinitis?

For Asthma (Take in the evening):
- One 10-mg tablet for adults and adolescents 15 years of age and older,
- One 5-mg chewable tablet for children 6 to 14 years of age,
- One 4-mg chewable tablet or one packet of 4-mg oral granules for children 2 to 5 years of age, or
- One packet of 4-mg oral granules for children 12 to 23 months of age.

For Seasonal Allergic Rhinitis (Take at about the same time each day):
- One 10-mg tablet for adults and adolescents 15 years of age and older,
- One 5-mg chewable tablet for children 6 to 14 years of age, or
- One 4-mg chewable tablet or one packet of 4-mg oral granules for children 2 to 5 years of age.

What should I avoid while taking SINGULAIR?

If you have asthma and if your asthma is made worse by aspirin, continue to avoid aspirin or other medicines called non-steroidal anti-inflammatory drugs while taking SINGULAIR.

What are the possible side effects of SINGULAIR?

The side effects of SINGULAIR are usually mild, and generally did not cause patients to stop taking their medicine. The side effects in patients treated with SINGULAIR were similar in type and frequency to side effects in patients who were given a placebo (a pill containing no medicine).

The most common side effects with SINGULAIR include:
- stomach pain
- stomach or intestinal upset
- heartburn
- tiredness
- fever
- stuffy nose
- cough
- flu
- upper respiratory infection
- dizziness
- headache
- rash

Less common side effects that have happened with SINGULAIR include (listed alphabetically):
agitation including aggressive behavior, allergic reactions (including swelling of the face, lips, tongue, and/or throat, which may cause trouble breathing or swallowing), hives, and itching, bad/vivid dreams, increased bleeding tendency, bruising, diarrhea, hallucinations (seeing things that are not there), hepatitis, indigestion, inflammation of the pancreas, irritability, joint pain, muscle aches and muscle cramps, nausea, palpitations, pins and needles/numbness, restlessness, seizures (convulsions or fits), swelling, trouble sleeping, and vomiting.

Rarely, asthmatic patients taking SINGULAIR have experienced a condition that includes certain symptoms that do not go away or that get worse. These occur usually, but not always, in patients who were taking steroid pills by mouth for asthma and those steroids were being slowly lowered or stopped. Although SINGULAIR has not been shown to cause this condition, **you must tell your doctor right away if you get one or more of these symptoms:**
- a feeling of pins and needles or numbness of arms or legs
- a flu-like illness
- rash
- severe inflammation (pain and swelling) of the sinuses (sinusitis)

These are not all the possible side effects of SINGULAIR. For more information ask your doctor or pharmacist.

Talk to your doctor if you think you have side effects from taking SINGULAIR.

General Information about the safe and effective use of SINGULAIR

Medicines are sometimes prescribed for conditions that are not mentioned in patient information leaflets. Do not use SINGULAIR for a condition for which it was not prescribed. Do not give SINGULAIR to other people even if they have the same symptoms you have. It may harm them. **Keep SINGULAIR and all medicines out of the reach of children.**

Store SINGULAIR at 25°C (77°F). Protect from moisture and light. Store in original package.

This leaflet summarizes information about SINGULAIR. If you would like more information, talk to your doctor. You can ask your pharmacist or doctor for information about SINGULAIR that is written for health professionals.

What are the ingredients in SINGULAIR?

Active ingredient: montelukast sodium

SINGULAIR chewable tablets contain aspartame, a source of phenylalanine.
Phenylketonurics: SINGULAIR 4-mg and 5-mg chewable tablets contain 0.674 and 0.842 mg phenylalanine, respectively.

Inactive ingredients:
- 4-mg oral granules: mannitol, hydroxypropyl cellulose, and magnesium stearate.
- 4-mg and 5-mg chewable tablets: mannitol, microcrystalline cellulose, hydroxypropyl cellulose, red ferric oxide, croscarmellose sodium, cherry flavor, aspartame, and magnesium stearate.
- 10-mg tablet: microcrystalline cellulose, lactose monohydrate, croscarmellose sodium, hydroxypropyl cellulose, magnesium stearate, hydroxypropyl methylcellulose, titanium dioxide, red ferric oxide, yellow ferric oxide, and carnauba wax.

What is asthma?

Asthma is a continuing (chronic) inflammation of the bronchial passageways which are the tubes that carry air from outside the body to the lungs.

Symptoms of asthma include:
- coughing
- wheezing
- chest tightness
- shortness of breath

What is seasonal allergic rhinitis?

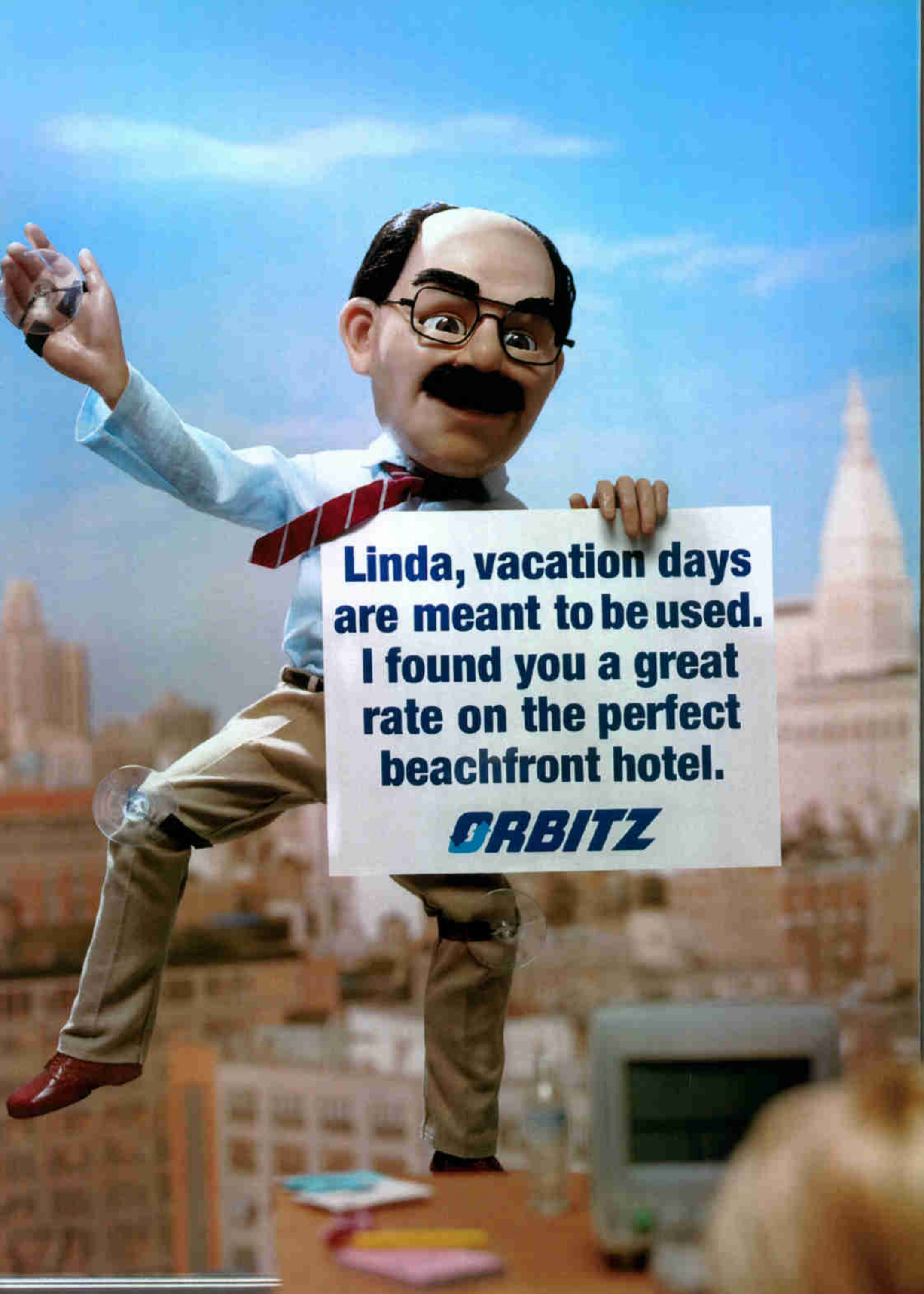
- Seasonal allergic rhinitis, also known as hay fever, is an allergic response caused by pollens from trees, grasses and weeds.
- Symptoms of seasonal allergic rhinitis may include:
 - stuffy, runny, and/or itchy nose
 - sneezing

Rx only

Issued May 2003

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Whitehouse Station, NJ 08889, USA
20450051(5)(216)-SNG-CON

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CHECKING IN

. . . With an Aging Mariner



In the mid-20th century the 220-foot fishing schooner *Creoula* made dozens of voyages from her home port of Lisbon to the cod-rich waters off Newfoundland and Greenland. The May 1952 issue of NATIONAL GEOGRAPHIC traced her long journey north.

Now *Creoula* has a new career. NGM-Portugal, one of the GEOGRAPHIC's local-language editions, has teamed with the Lisbon Oceanarium to offer members whale-watching expeditions aboard *Creoula.* Passengers do some navigating, stand watches, and tackle other shipboard chores along the way—but they won't be doing any cod fishing.

ANTÓNIO GONÇALVES

we see

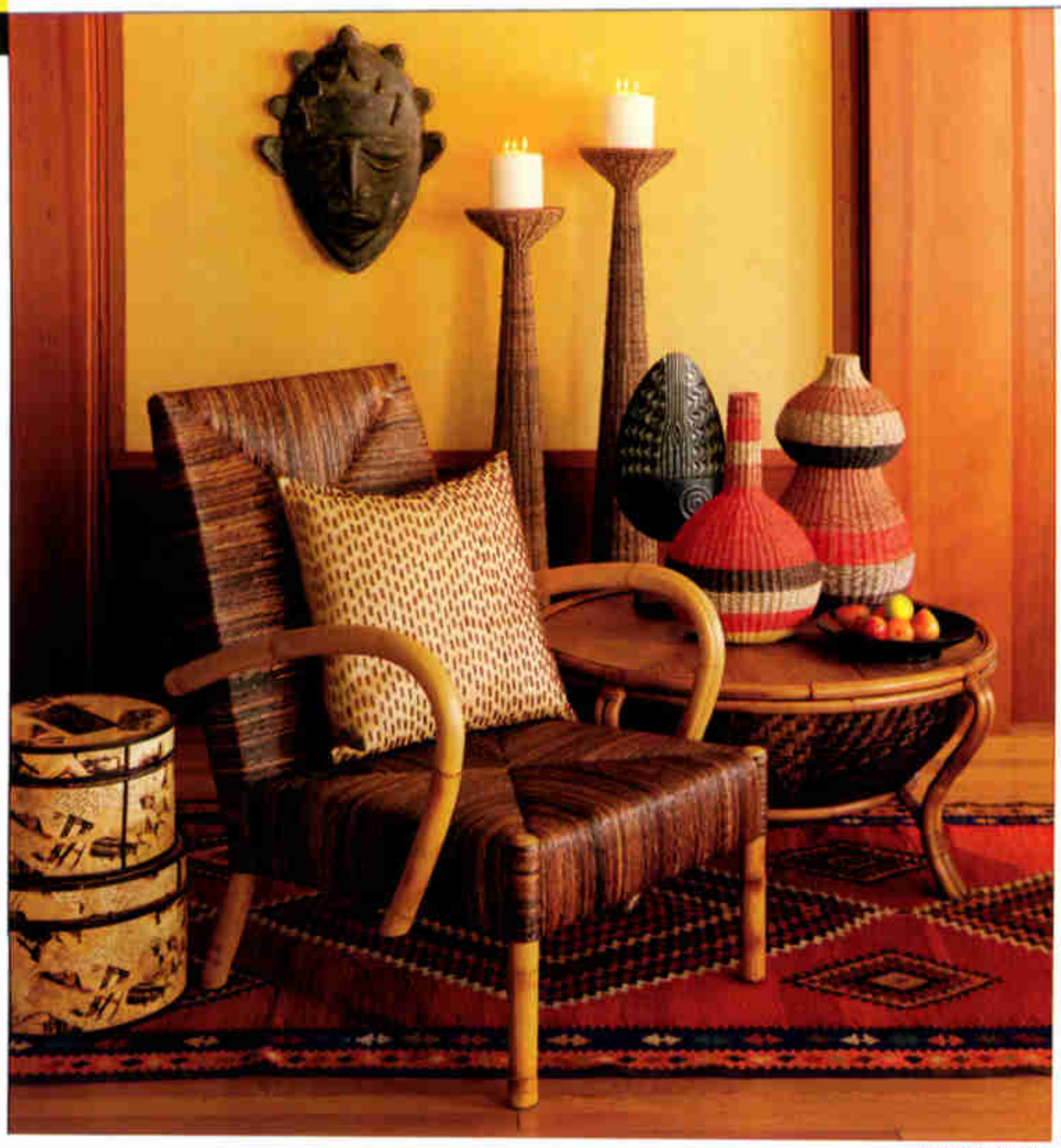
nothing small about them.

Kids are so full of potential. They can become anything they dream, and with the right teachers and the right tools, they will. We stand in awe of kids and their potential. We're inspired to create software that helps them reach it. microsoft.com/potential

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PALECEK (BOTH)

Furniture With a Story

NGS does its research, launches Home Collection

Every picture may tell a story, but can chairs, tables, even suitcases have stories too? National Geographic Enterprises thinks so and has developed a line of home furnishings, each collection with its own cultural story backing it—or in some cases covering it.

Take the decorative suitcase below. It's covered in a reproduction of a Portuguese seafarer's map from the Society's rare book collection. Facsimiles of turn-of-the-century postcards and stamps adorn hatboxes (above, at left); a round coffee table, at right, resembles drums used by the people of Mali.

The hundreds of pieces in the Home Collection come with tags explaining their inspiration. Researchers combed our archive of rare books, stamps, vintage postcards, and 115 years' worth of NATIONAL GEOGRAPHIC, gathering ideas for the decor designers. Photographers, writers, and explorers who travel the world for us were quizzed about their own home furnishings—in particular, pieces brought back from faraway places—and some of the items in the collection are based on their personal favorites.

Debuting this month, the furnishings will be sold in stores in the U.S. and Canada. For more information go to *shopNG.com* or *lanefurniture.com*. All Geographic net proceeds from Home Collection sales go to support the Society's World Cultures Fund, dedicated to the study and conservation of cultures around the globe. Read about the fund at *nationalgeographic.com/help/wcf*.



SPECIAL EDITION POSTER

Poster Pup



Tears cling to the eyes of newborn harp seals. "They lack the ducts that remove excess fluid, so they're always crying," explains biologist Mike Hammill. "It tugs on your heartstrings." Since antisealing activists used the pups as a symbol during their campaign against seal hunting, Canada has banned commercial harvesting of whitecoat harp seal pups. Hunted or not, the harp seal makes a good poster pup, so we've featured Brian Skerry's photograph from the March issue as our latest selection.

The poster is available for $29.95 plus $6.95 for shipping ($9.95 for international orders). Appropriate sales tax applies to orders sent to CA, DC, FL, KY, MI, PA, VA, VT, and Canada. We will produce only as many 24-by-20-inch posters as we receive orders for by midnight on April 30, 2004. Each will be hand-numbered and embossed with the Society seal. Shipping is scheduled for June 2004. Call toll free: 1-888-647-6733 (outside the U.S. and Canada call 1-515-362-3353) or order online at *nationalgeographic.com/magazine*.

EMERGING EXPLORER MARK OLSON You can't keep a creative plant biologist down—not if it's Mark Olson. Determined to get a fresh perspective on tree diversity, Mark conducts field research from a powered paraglider. Since plants collect light for photosynthesis from above, his study aims for a more biologically relevant view than a traditional one rooted on the ground. By soaring over the treetops, Mark gains a bird's-eye view that reveals valuable new insights about plants, many that have amazing nutritional and medicinal benefits for people around the world.



Getting a bird's-eye view of plant diversity

"THE WORLD IS SO WONDERFULLY FULL OF AMAZING FORMS, SHAPES, AND SIZES OF PLANTS—how did this diversity arise? Searching for answers led me to study Moringa*—a real modern-day miracle plant for people in hot, dry tropical areas. The leaves and fruits are nutritious, and the seeds can be used to clarify muddy water! We're even testing the ability of leaf compounds to help prevent human illnesses. Gathering samples from all around the world, and bringing millions of years of evolution together in the lab where these plants can tell their stories, is incredibly inspiring."*

—Mark Olson, Plant Biologist

Around the world, National Geographic Society has identified Emerging Explorers Program grantees who push the boundaries of discovery. Visit nationalgeographic.com/emerging.

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Microsoft recognizes the crucial role technology plays in exploration. Their support of the National Geographic Emerging Explorers Program is helping these new explorers realize their potential.

Photos: Jim Webb

ADVERTISEMENT



Technology branches out.

Plant biologist Mark Olson needs technology that can help him study the world from every angle—up mountains, along rivers, even from the air. The powerful Tablet PC is a fully functioning notebook PC and is as simple to use as a pad and pen. This flexible tool makes it easier than ever for scientists and explorers to record data in the field, insert graphic elements, and organize and share information. The Tablet PC runs the full range of Windows® XP compatible applications, including the new Microsoft® Office System, so they can be at your command wherever you go. See how it can help you grow in new directions at microsoft.com/tabletpc

Microsoft® Windows® xp Tablet PC Edition

**OneNote software not included with the Tablet PC and must be purchased separately.*

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Who Knew?

GEOLOGY

To the Center of the Earth

A new way to dig really deep

A nagging problem for humans, a species that likes to brag about all the distant planets and moons it has surveyed, is that we've never taken a good look right under our noses. The interior of the Earth is tantalizingly close, by cosmic standards, but how do you get there?

The deepest oil well penetrates a mere six miles into the crust (the center of the Earth is about 4,000 miles deeper). Russian scientists dug the deepest hole on the planet in Siberia, but bottomed out at about 7.5 miles below the surface. The Mohole project, a 1950s-era U.S. plan, called for drilling a hole 25 miles down to the Mohorovicic discontinuity, the boundary between the hard rocks of the crust and the gooey mantle. Sadly, the only discontinuity Mohole ever encountered involved government funding.



It gets harder and harder to drill deep into the Earth because rocks get softer and softer. Brittle at the surface, rocks become plastic at depth, and the pressure caused by the weight of the overlaying crust—about 52,800 pounds per square inch at a depth of ten miles, says drilling consultant William Maurer—collapses deep wells, making further drilling impossible.

What little we know about the interior of the Earth (like the fact that there's a crust, a mantle, and a core, or that there aren't mole people down there) comes from indirect evidence, such as the analysis of earthquakes.

So maybe it's time for a radical new approach to exploring Earth's interior. Caltech planetary scientist David Stevenson says we should forget about drilling holes. Instead, we should open a crack.

Stevenson proposes digging a crack about a half mile long, a yard wide, and a half mile deep (not with a shovel—imagine the back strain) but with an explosion more on the scale of a nuclear bomb. Next, he'd pour a few hundred thousand tons of molten iron into the crack, along with a robotic probe. The iron, denser than the surrounding crust, would migrate downward at about 16 feet per second, carrying the probe with it and opening the crack deeper and deeper. The iron blob would drop for about a week and 2,000 miles to the outer edge of the Earth's core, the probe beaming data to the surface.

Stevenson compares his idea to space exploration. "We're going somewhere we haven't been before," he says. "In all likelihood, there will be surprises."

This proposal can probably be filed in the drawer marked Ain't Gonna Happen. The probe would have to survive temperatures that would melt pretty much anything. It could get sidetracked if the iron started flowing through preexisting cracks in the Earth. And just think of the environmental impact statement. But Stevenson's idea may inspire a new look at an old problem. Great things can come from what seem like crackpot notions.

—Joel Achenbach
WASHINGTON POST STAFF WRITER

PHOTO ILLUSTRATION BY CARY WOLINSKY AND DAVID DERANIAN

IT MATTERS

It's hot down there. Really hot— 9932°F at the Earth's core according to scientists at University College London. (That's nearly as hot as the surface of the sun.) All that geothermal energy moving out through the mantle and crust can cause devastating earthquakes and volcanic eruptions. But it also creates a resource that matters. U.S. power plants using geothermal energy to generate electricity emit 22 million fewer tons of carbon dioxide annually than similar-capacity plants burning fossil fuels. Italy's Larderello geothermal field powers 1.5 million households. And Iceland's industry and commerce minister calls geothermal energy a pillar of her nation's well-being. It heats 88 percent of Icelandic housing and meets more than half the country's total energy needs.

—Lynne Warren

WEBSITE EXCLUSIVE

For more about Earth's interior and for links to Joel Achenbach's work, go to Resources at **nationalgeographic.com/magazine/0404.**

THE HARD SCIENCE, DUMB LUCK, AND COWBOY NERVE OF CHASING TORNADOES





BY PRIIT J. VESILIND
PHOTOGRAPHS BY
CARSTEN PETER





June 24, 2003

The tornado of a lifetime snakes down a South Dakota road toward Tim Samaras, an engineer and avid tornado chaser from Denver. Minutes earlier, the storm had destroyed the tiny village of Manchester, fortunately with no loss of life. Samaras and a National Geographic team spent months on the front lines of severe storms research. Their mission was to place weather-measuring probes in the path of a tornado—then get out of the way.

The chasers speed away, debris roaring in above them: Nails, wire, two-by-fours whip by in winds that soon reach 200 miles an hour.

7:40 p.m.

Cut off by the tornado as it rushes toward the road (below right), the chasers pause to plot their route. A wrong turn could be fatal. 7:46 p.m. Fishtailing over a muddy road (below left), the team races to get ahead of the twister and plant probes in its path. 7:50 p.m. Thinning into a rope shape (left and preceding pages), the tornado crosses the road, snapping power poles and fences.





Around dinner hour on June 24, 2003, the entire hamlet of Manchester, South Dakota—walls and rooftops, sheds and fences, TVs, refrigerators, and leftover casseroles—lifts from the earth and disappears into a dark, thick, half-mile-wide tornado. The pieces whirl high in the twister's 200-mile-an-hour winds, like so much random debris swept clean from the landscape. A mile or so north of town 36-year-old Rex Geyer pulls the curtains back from the window of an upstairs bedroom and watches Manchester disappear. Rex stands frozen. The tornado seems to be standing still too, not moving one way or the other. It takes him a fearsome minute to realize what that means—

that the deadly storm is coming straight for him. Just earlier, Rex had sat down to fried chicken with his wife, Lynette, who is eight months pregnant. "We had heard about some wicked tornadoes down in Woonsocket, where Lynette's from," he would say later. "We were keeping our eyes on the TV, and I was looking outside, and I said, 'Well, geez, it don't really look that bad.'" But now rain is pounding down, obscuring the monster storm bearing down on his two-story farmhouse. Rex's brother Dan, who lives up the road, charges into the house. "He almost rips the screen door off the hinges, and he's hollering, 'We gotta get into the basement!' But I just saw the Manchester debris and don't think we'll survive in the basement, so we pile into Dan's car."

"Should I turn the lights and the TV off?" Lynette asks. She hasn't seen the storm.

"No, no! We have to go now!" They leave everything but a mobile phone.

As they flee, two cars hurtle down a nearby dirt road in the opposite direction—straight at the tornado. Tim Samaras, a 45-year-old electronics engineer from Denver, and his storm-chasing partner, Pat Porter, are in a van that carries six probes, often called "turtles"—squat, 45-pound metal disks that look like flying saucers. Through embedded sensors, the probes can measure a tornado's wind speed and direction, barometric pressure, humidity, and temperature. Samaras's mission, and his passion, is to plant them in the path of the funnel. His hope is that both he and the instruments survive.

Photographer Carsten Peter hangs halfway out the window of the other speeding car, which is driven by veteran storm chaser Gene Rhoden. With them is another kind of probe, a pyramid-shaped aluminum casing loaded with a video and three 35-mm still cameras. Tinman, the team calls it, based on the character from *The Wizard of Oz*. No one has ever filmed the inside of a tornado—where wind can chew asphalt off a road and drive wooden splinters into tree trunks. Carsten wants to be the first.

The chasers can hear the tornado's jet engine roar and see it snapping power poles as they veer

east onto a paved road, past the Geyers' farm and directly into the path of the funnel. Tim skids to a halt to make a drop. "We don't have time! We don't have time!" Pat yells. The monster is plowing up ground only a hundred yards away, and the inflow wind is revving up as Tim leaps out just long enough to deposit a probe before scrambling back in. As the chasers speed away, they can see debris roaring in above them: Nails, wire, two-by-fours whip by in winds that will soon reach 200 miles an hour.

Moments later the cars stop again a short distance down the road. Carsten and Gene haul the 95-pound Tinman from their car onto the roadside and activate the cameras while Tim drops another turtle. Two so far. Good, good. But now the tornado is chasing them.

They blast down the road once more, and Tim deploys a third probe. Tinman and two of the three probes take direct hits. The tornado reaches one probe a mere 80 seconds after Tim sets it in place. But suddenly the fury is spent. The tornado changes shape, stretching out long and ropey before rolling limply to the side. And then it simply evaporates.

Tornadoes are among Earth's most violent natural acts. About a thousand of them touch down in the United States each year, more than in any other country in the world (see map, pages 18-19). Some are wispy and last only seconds, others rampage across the landscape for more than an hour, but few are as destructive as the one that obliterated Manchester.

By definition tornadoes are rotating columns of air that extend from swelling cumulonimbus clouds to the ground. No one fully understands tornado dynamics, but certain ingredients seem essential to the witches' brew from which twisters emerge: warm, humid air near the ground, colder air aloft, and shearing winds that change direction and speed with height. The most destructive and deadly tornadoes form under the bellies of supercells, large long-lived thunderstorms whose winds are already in rotation. It was a supercell that gave birth to the Manchester tornado.

SOCIETY GRANT

This project was supported in part by your Society membership.

Forty percent of all U.S. tornadoes occur in the central plains states from March through July, when cool, dry air from the Rocky Mountains clashes with warm, moist undercurrents from the Gulf of Mexico. In such open country you can see entire supercells, some 30 miles wide, bulling over the land, spitting rain and hail, their cauliflower tops bursting into the stratosphere. But only one in a thousand thunderstorms becomes a supercell, and only one in five or six supercells spawns a tornado.

Because it's so difficult to measure tornado winds and power, scientists measure tornadoes by the damage they cause. On the Fujita scale, developed by Ted Fujita of the University of Chicago, an F1 storm does moderate damage with hundred-mile-an-hour winds. An F5 is horrific. The Manchester tornado was an F4.

Today's warning time for tornadoes—the time a family faced with catastrophe has to gather essentials and bolt for the basement or nearest storm shelter—averages 13 minutes. Most warnings rely on the 121 radar stations of the National Weather Service, but conventional weather radar can miss the birth of a tornado in the five to six minutes it takes a unit's single beam to cover its range. Now scientists at the National Severe Storms Laboratory (NSSL) are working to adapt a shipboard system from the U.S. Navy—the Spy-1 phased array radar—for meteorological use. Spy-1 sends out multiple beams in continuous rotation and is five times faster than conventional radar.

For three springs Carsten Peter and I pursue supercells and tornadoes with Tim Samaras, with Anton Seimon, a geographer from Boulder, Colorado, and with some other of America's best storm chasers. We cover more than 50,000 highway miles, lugging Tinman around faithfully. We hit severe weather that rattles our teeth and pits our cars with hailstones. We witness skies of transcendent beauty. And we endure the gypsy life of the storm chaser—truck-stop motels, late-night Subway sandwiches, and dogged resolve. Mostly we tilt at windmills; we see only a few tornadoes. And, as it turns out, we won't really succeed until the last hours of our last day afield.

Only a grotesque, shredded landscape remains of Manchester, formerly a cluster of six houses. Nearly 70 tornadoes emerged from a wave of high-energy thunderstorms in South Dakota that day. On the Fujita scale, which measures tornado damage, the Manchester winds earned an F4: "devastating."





THE HUNT BEGINS

During peak season, hundreds of



"The storm sky's like a chorale with thunderous organ music," says tornado chaser Anton Seimon. To get front-row seats, scientists take to the road to intercept storms. Beside his instrument-topped chase car from the National Severe Storms Laboratory (right), meteorologist Albert Pietrycha scans a majestically rotating sky. To measure wind speeds at close range, Doppler on Wheels (DOW) radar trucks (above) wait for twisters such as this "elephant's trunk" in Nebraska (left).

We base ourselves in Boulder in the foothills of the Rockies, where the Great Plains stretch before us like a giant stage. From here we can reach nearly anywhere on the plains with a day's drive. For the first season, 2001, we hook up with Anton, Tim, and an all-star group of scientists in a six-car chase motorcade. Guiding us are several "nowcasters," meteorologists who continuously monitor weather information and send directions to us on the fly by cell phone.

Our main nowcaster is Erik Rasmussen, a tornado researcher with the University of Oklahoma and one of the brightest stars in severe-storm meteorology. Through numerical computer models, constantly flowing weather maps, and intuition, he can sit at home in his bathrobe and calculate where the best supercell will arrive each day by six o'clock p.m., magic hour for tornado formation. "It's me against the atmosphere," he says. "I try to outguess it."

On May 25 Erik points us to the Texas Panhandle, where conditions look right for spawning a supercell. Our task is to find this incipient monster, if it forms, get just to the southeast of

it (the best position for Carsten to get revealing backlight), watch it develop, and ensure we can make a getaway if things get dicey.

When we arrive in Texas, we're not alone. In tornado country, especially since the 1996 motion picture *Twister,* storm chasing has become a phenomenon. During peak season hundreds of people fan out over Tornado Alley, a belt between South Dakota and Texas. Their vehicles bristle with radio antennas and radar dishes, their dashboards outfitted with computers and satellite-linked televisions.

"Everyone can read the weather maps now," says Stephen Hodanish, a lightning specialist with the National Weather Service whom we meet in a honky-tonk one night. "The information is shared. We don't hide it. So we all know where to go."

Some tornado chasers think of it as a clever computer game come to life. Others become intimate with the atmosphere, the way a trail guide learns to know the woods. Recently, skilled chasers have formed companies that take tourists on "tornado safaris," competing to see who

people fan out over Tornado Alley, between South Dakota and Texas.





An unsettled sky sizzles with lightning as Seimon chases a storm. Most tornadoes emerge from supercells, long-duration thunderstorms that build rotation from the mix of atmospheric instability and wind shear. Even supercells that don't spawn tornadoes can do major damage with intense lightning and apple-size hail.



can get clients the best views of the storms. But it's not like going to, say, Niagara Falls, which stays put. Tornadoes are unpredictable, and a wrong decision can be hazardous. I have seen tour buses with windows shattered from hail, the passengers shaken but exhilarated.

Research scientists are out there forecasting and chasing too, of course—teams from meteorological departments at universities and from the NSSL in Oklahoma, where much of today's pioneering work is done. But science of this kind is challenging, for tornadoes resist analysis, and

Chasing tornadoes is like hunting grizzlies: You want to get close, but

creative computer models can take researchers only so far. "The tornado has become the black hole of meteorology," says Anton. "We really don't know how it works."

To get a better handle on that question, research meteorologists Howard Bluestein, from the University of Oklahoma at Norman, and Joshua Wurman, from the Center for Severe Weather Research in Boulder, join in the hunt each spring. Stationary radar can't see fine detail in distant storms because a radar beam loses focus over long distances, so Wurman's Doppler on Wheels (DOW) radar trucks intercept the storms and study their hidden structure at close range. Bluestein's new mobile Doppler radar has a beam so focused it can detect wind features as fine as 20 to 30 feet across.

But field programs like these can be counted on one hand, so an extraordinary symbiosis has grown between severe-storm meteorologists and serious-minded amateur storm chasers. "The scientific community likes to crunch numbers," says Lance Bosart, a professor of atmospheric science at the University at Albany, whom I meet at a rest stop in Kansas. "The chase community likes to get there and see things. We want to have readings *from* as many points as we can, and we need all these people to fill in the blanks."

Amateur chasers may even play a role in an ambitious project planned for the spring of 2007, when dozens of scientists will attempt to surround storms and gather data from every angle.

We reach Texas in time, but Erik's designated storm dissipates into a ragged line of squalls that runs off into the Gulf of Mexico. "We don't chase squall lines," says Anton. "They don't have the vorticity." They don't twist, in other words. We caravan in the Texas Panhandle for days, Merle Haggard on the radio, tooling down the straightest roads in the world, chasing storms that only tease and don't deliver. "HP storms," Tim says disgustedly. "High precipitation pieces of crap." Sleep and nutrition suffer. Sometimes dinner is a bag of corn chips, some beef jerky, and a Coke.

By the middle of June we give it up, leaving 2001 as a good year for those who live in Tornado Alley, but a total bust for us.

The following spring, 2002, we carry our own technology instead of relying on nowcasters. Tim has customized his white Dodge Caravan into an intimidating storm-busters vehicle. A domed television antenna sits on its roof. Screens display Weather Channel broadcasts, global positioning system (GPS) readouts, National Weather Service data, and NOAA satellite images. The van is like a submersible diving into the atmospheric sea.

"A nowcaster is continuously poring through the data," says Tim, "but I'd rather pore through the data myself and then look out the window to see what's developing."

On the early morning of May 23, we're in a cheap motel room in Salina, Kansas, clutching foam coffee cups, pulling weather reports off the Internet. "The Midwest is a chessboard," says Anton. "We stopped play last night, but the atmosphere made several moves overnight, so we tune in to see what they were. And now we have to make our move."

It looks promising. A heavy wind has been unloading on the prairie, twisting the cottonwood leaves onto their pale backsides, leaving grain fields squirming. We head out with the skies overcast, like dirty fleece hanging off an old sheep. Thunderstorms are raging to the south. We haul across the Oklahoma border and reach again into the Texas Panhandle. By 4:40 we're in cattle country, where the towns are rawboned, as if the buildings had been scoured into packing crates by the prairie wind. We pull into Lipscomb, Texas, and a car full of local women rolls up.

"You boys bringin' bad weather here?"

"It's not like we want it for you," I reply.

"Hah. It's not like we're not used to it."

But we're late, and out of position. If we try to drive around the storm, we won't have enough daylight left to see it. So we decide to "punch the core" of the thunderstorm, forcing our way into the "bear's cage," an area between the main updraft and the hail. It's an apt name: Chasing tornadoes is like hunting grizzlies—you want to get close, but not on the same side of the river. Sometimes you get the bear; sometimes the bear gets you.

not on the same side of the river.

And so we head straight into the storm and find ourselves splattering mud at 60 miles an hour on a two-lane road, threatening to hydroplane, visibility near zero. Anton is less than comforting. "The hail in the bear's cage smashes windows and car tops," he shouts, grinning. "The smaller stuff is kept aloft by the updraft, and only the large chunks fall. It's like small meteorites banging down. Ha-ha-ha!"

When the storm spits us out, we stop to look back at the supercell steaming across the prairie. Its top is shaped like a giant anvil, and lightning flashes from it like artillery. Stacks of cumulonimbus clouds pompadour from its top, and dark wisps of clouds curl like imps from the "wall cloud" that has dropped from its rear flank; that's where tornadoes are known to originate. We sprint into position down a country road and—how does this happen?—pull onto a field full of at least ten other chase cars.

"This storm has the only tornado warning in the nation this evening," Tim explains, "and we're standing in the right place." With all the others. Down the road are the headlights of local spotters, many of them sheriff's deputies. Spotters will react on the side of caution, and account for many false tornado sightings. "Sheriffnadoes," some chasers call these. But spotters' vigilance saves lives and property.

The supercell moves in with an immense, dark, roiling tapestry of clouds that leaves us gaping. Hail roar—hailstones clattering against each other as they fall from high in the storm—resonates like a Harley-Davidson. The storm does not deliver a tornado, but after it passes, lightning scorches the sky for half an hour.

Brad Carter, Tim's chase partner for this trip, shakes his head. "It took me four or five years of driving before I saw my first tornado," he says, "and I've been out here nine years now. If I had seen one right away, on the first trip, maybe I wouldn't have gotten so hooked."

Disappointments arrive daily now. The morning strategy sessions, the long drives, the wild chases across the High Plains, the spectacular busts. It's been two years now without a tornado worth documenting. "We should hire ourselves out as storm-prevention people," says Tim. "Everywhere we go, the storms fizzle out."

The 2003 tornado season is another matter entirely. It starts with an explosive string of May storms that roar through Arkansas, Tennessee, and Missouri, leaving entire towns for dead. But we're still either a step behind or a step ahead. On the way to Colorado, my chase partner, Scott Elder, and I pull into Pierce City, Missouri, where just two weeks before an F3 had flattened homes and left the tidy brick shops and restaurants on the town's main street in rubble.

"We don't have a grocery store left in town," says the police chief, Mike Abramovitz. "It's amazing only one person got killed." That was James Dale Taunton, 51 years old, who had positioned himself in the doorway of the town armory, helping people who sought shelter in the building's basement. Sixty survived there.

Over pancakes one morning, Jon Davies, a veteran meteorologist from Kansas, outlines a paradox. "It's so hard to reconcile the destruction of towns and people suffering," he says, "with something you enjoy doing. You won't see me whooping and hollering under a tornado. These things turn people's lives upside down."

Tornadoes have also ripped the southern plains in the 2003 season, and by the time Carsten, Scott, and I join Tim and Anton for the chase, they have already dropped one probe into a Texas twister. Joshua Wurman's DOW trucks were out on the same storm, so there is complementary data to feed into the computer models. Tim, funded this year by NOAA and a grant from National Geographic's Committee for Research and Exploration, has now successfully deployed four probes in two years. Before his project, in more than ten years of trying, scientists had managed to place such an instrument exactly once: A team from New Mexico Tech made the first successful drop in 1995.

MIGHTY WINDS

Deadly brushstrokes of tornado paths underscore the fact that the United States suffers more tornadoes than any other nation. A thousand or so touch down in the continental U.S. each year as warm, moist air from the Gulf of Mexico clashes with cool, dry air flowing eastward off the Rocky Mountains. The storms, which typically move from southwest to northeast, claimed 55 lives in 2002. But tornadoes are a global menace (map below). Wherever warm, humid winds blow over continental land masses, twisters are possible.

CANADA
UNITED STATES
MONT.
N. DAK.
S. DAK.
Manchester tornado June 24, 2003
WYO.
NEBR.
Boulder
COLO.
KANS.
N. MEX.
OKLA.
TEX.
U.S.
MEXICO
Rocky Mountains
High Plains
Great Plains
TORNADO ALLEY
0 mi 100
0 km 100



MINN.
WIS.
MICH.
IOWA
IND.
OHIO
ILL.
MO.
KY.
W. VA.
VA.
TENN.
N.C.
ARK.
MISS.
S.C.
GA.
ALA.
LA.
FLA.
CANADA
U.S.
ME.
VT.
N.H.
N.Y.
MASS.
CONN.
R.I.
PA.
N.J.
MD.
Washington, D.C.
DEL.

Atlantic Ocean

Gulf of Mexico

U.S. TORNADO PATHS
January 1950 - June 2003

Fujita scale		mph	kmph
F5	Incredible	261-318	420-512
F4	Devastating	207-260	333-419
F3	Severe	158-206	254-332
F2	Significant	113-157	182-253
F1	Moderate	73-112	117-181
F0	Gale	40-72	64-116

SOURCES: DANIEL W. McCARTHY AND JOSEPH T. SCHAEFER, NOAA NATIONAL WEATHER SERVICE; HAROLD E. BROOKS, NOAA NATIONAL SEVERE STORMS LABORATORY

NATIONAL GEOGRAPHIC MAPS



WATCHING AND WAITING



We cover more than 50,000 highway

In a car topped with instruments that read the atmosphere's vital signs—temperature, humidity, barometric pressure, wind speed and direction—chasers from the National Severe Storms Laboratory await the sky's next act as the curtain of an approaching storm falls across the sun (right). Will it spawn a tornado? Not this time. Cattle in Nebraska (above) graze oblivious to another baleful storm moving in. Such storms often end on a serene note, with a flock of mammatus clouds (left) hanging softly above.

By June 4 we're in a caravan of four cars barreling back down to Texas, where we chase a supercell tagged with a tornado warning into Clayton, New Mexico. On a farm road between fallow cornfields, we find ourselves perpendicular to the storm's inflow wind. Hail hacks at our rooftops. Red-brown soil flows across the road like liquid waves.

And then the world seems to simply disappear. I can see nothing but Tim's red brake lights in front of us. The convoy grinds to a halt as a sandstorm rages, its winds approaching 70 miles an hour, Tim estimates. Somewhere out there a tornado may be brewing. Tim's van begins to rock. Anton's face turns ashen. We can't see the road, only the tops of telephone poles. Twenty minutes pass. Tim finally radios us: His GPS shows a T intersection in the road ahead that we could reach, and so we roll blindly, foot by foot, out of the sandblaster.

"Some storm," Tim says later. "I don't think I've ever seen anything like it." We head east with dirt still caking our cars, the fenders butting tumbleweeds as big as washing machines. We

learn later that there was a tornado somewhere in that storm, but we sure as hell couldn't see it.

Our field time is running out when we caravan into northern Nebraska on June 9. Dew points are looking good there, and the National Weather Service promises a convergence of shearing winds. For the 30th time, this may be the day we finally see a tornado. We head into the undulating dunes of the Sand Hills. The AM radio crackles with static. Turkey towers—tall, thin cumulus clouds that bubble upward—trot along the northwestern horizon.

"I like the shear," Tim says into the walkie-talkie. "There are two updrafts, maybe three, dead ahead of us—actually a bit of an anvil coming eastbound. We'll get off the highway and assess the situation."

Guided by the usual mix of computer images and eyeballing, we zigzag toward the South Dakota border, and by late afternoon we're in storm mode. A dark anvil lowers in the hurly-burly western sky. Hanging beneath it is a wall cloud—like an outboard motor to the vessel of the supercell. Nervous technical jargon flies back and

miles. We hit severe weather that pits our cars with hailstones.



A rare formation that storm chasers call a mother ship sweeps across the Texas Panhandle just west of Childress. Although the team tracked this supercell thunderstorm for seven hours across 150 miles, the chasers never spotted any of the four small funnel clouds it reportedly spawned.

forth: "21Z analysis field shows a 997 millibar low developing southward around Ogallala," Tim radios.

The sky is now rotating majestically, and a confused bird flies into our windshield with a thump, leaving a stain of blood and feathers. And then a triangle of cloud lowers and sharpens into something pointier and leaner. It gathers into a funnel like an elephant's trunk, with the texture of soft gray cotton. It whirls like an apparition, no more than two miles from us, looking alien in the landscape, as if a spaceship had landed. So, it's happening—after three years of futility. I'm finally going to see a tornado.

The tornado snakes down to the fields, where it's chewing up a maelstrom of soil and vegetation. It seems to stand almost still, and suddenly it's gone! It just lifts up, as if the sky were withdrawing a finger back into its fist.

But we're still racing toward the core of the storm, which will probably spawn more tornadoes. Flashing lights and hee-haw sirens of emergency vehicles roar by. The sky looks heavy enough to sink and crush us when we see another twister bullying across the fields—a squat, malevolent-looking wedge. But it's already past, and we're too late to catch it. We drive to Orchard, Nebraska, the hail still pelting the cars in the approaching darkness.

We're gleeful just to have seen tornadoes, but Anton tosses cold water on the celebration as we heat sandwiches in a gas station microwave. "We had two quality tornadoes that crossed roads, and we were out of position," he lectures. "Had we been three minutes earlier to the first storm, we would have been there for deployment. This was a total project failure."

Most of us won't get another chance. Scott, my chase partner, has already returned home, and now it's time for Anton and me to move on to other projects. But Carsten stays behind with Tim, insisting on a little more time. Over the next two weeks they grow increasingly frustrated. Tornado chasing season is usually over by mid-June. By June 23 they have only one field day left, and Tim is "starting to doubt whether we know what we're doing."

And then the Manchester tornado hits.

When the tornado retreats in that fearful twilight, Tim and Carsten find the countryside obliterated of landmarks. "It's an eerie situation," says Carsten. "First this beautiful, perfect structure coming toward you and this smooth, rushing noise, and then everything is eaten up—everything. Power poles are sucked up out of the ground, all the steel wires are ripped off the metal fences, and the fences are blown down flat, leaving nothing but a pristine meadow. It's really crazy."

Rex Geyer and his family drive through the

A triangle of cloud lowers and sharpens. It whirls like an



In a dance of nerves, Tim Samaras sprints back to the car after planting a bright orange probe in the path of a charging tornado near Woonsocket, South Dakota. In more than a decade of attempts only five such instruments have been successfully deployed—four by Samaras. "I take pride in getting to the right spot," he says.

remains of Manchester with terror in their hearts. They look north. Their tan, two-story farmhouse should be there, set in a grove of trees. Please, please. "But I knew right away," says Rex. "There was nothing left, no trees, no house, no nothing. Just the foundation—picked clean."

Two large, full fuel tanks had been blown into the Geyers' cellar, completely filling the space. Those tanks would have crushed anyone taking refuge from the wind.

Less than an hour before, Tim and Carsten had left three probes and Tinman in the path of the storm. Sobered, they now retrace their steps, hoping to find the instruments intact. "I'd swear we put one of the probes here," Tim says, arriving at a crossroads, "but nothing looks the same."

The air is juicy with the tang of mangled vegetation and evaporating moisture. Among the first on the scene, they check the bleak remains of another missing farmhouse, Harold Yost's home, but no one's there. In Manchester, home to only six people, it seems a miracle that no one died, since they all decided to ride out the storm. One couple survived by *(Continued on page 34)*

apparition, looking alien in the landscape, as if a spaceship had landed.





EYE OF THE TINMAN

Awaiting the blow, a camera unit specially built by National Geographic photo engineers lies in the path of the Manchester tornado (above). Called Tinman, the unit was designed to document the inside of a funnel with still images and video. Tinman stood its ground long enough to fire off a few still frames before tumbling hundreds of feet across the field. The video was ruined, but these photographs (right) may be the closest ever taken of a tornado funnel. Seconds after these images were made, the funnel flicked away the 95-pound camera unit. Samaras's probes, which house weather instruments but no cameras, held up better. The towering funnel (left) passed over one of the probes 80 seconds after Samaras set it in place. "This is the most dangerous drop we've ever done," he says.

CARSTEN PETER © NATIONAL GEOGRAPHIC SOCIETY



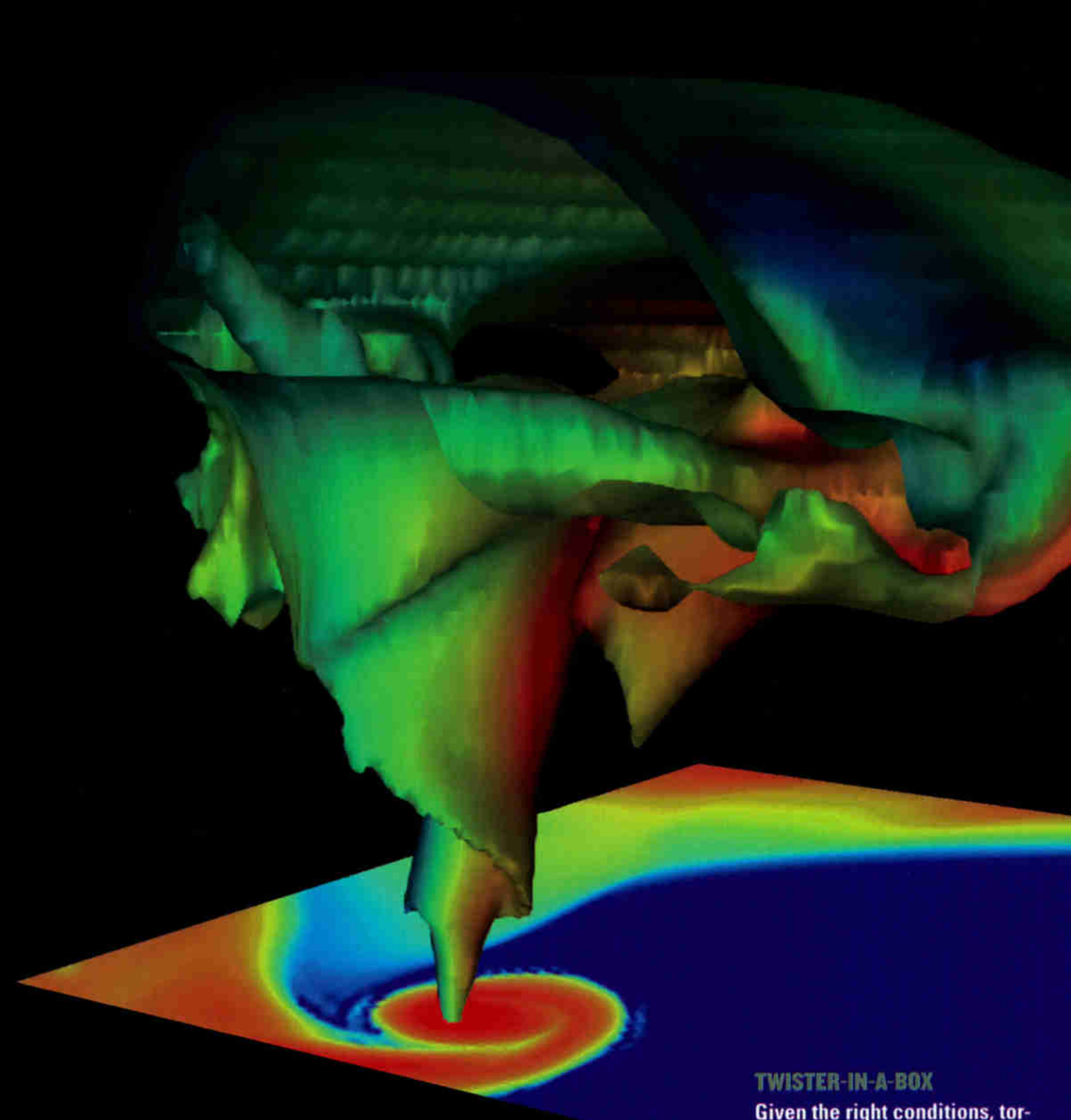
INSIDE A TORNADO

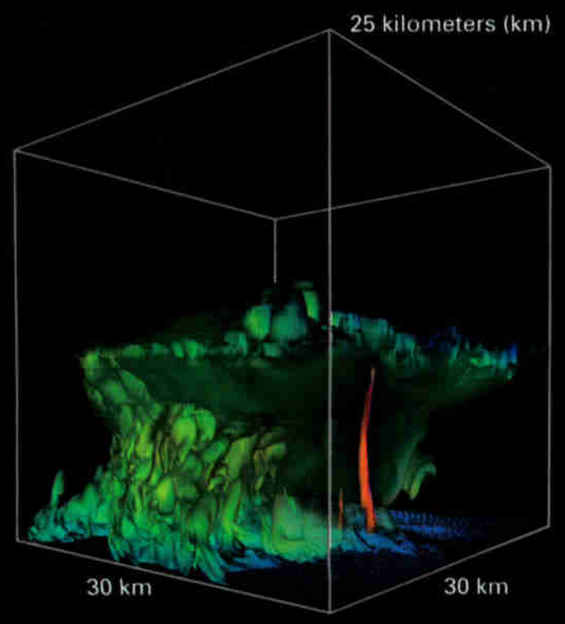
ON THE ROAD, IN THE LAB

How do you measure a charging bull? That's the challenge for meteorologists when faced with phenomena as overwhelming as the Manchester tornado (above). Like a bull, a tornado violently resists examination. It may come on suddenly from an unexpected place and last only a few minutes. Data from radar, weather balloons, and turtle probes can fill only part of the grid of information needed to comprehend tornado dynamics. So tornadoes remain the black holes of meteorology. Exactly how and why they form, and what drives their terrible power, are only partially understood.

And yet the essential steps that lead to tornadoes are known: A column of rising air forms at the boundary of air masses that differ in moisture and temperature. Then shearing winds—winds of varying speed that blow at cross directions at different altitudes—set the updraft spinning. These conditions produce a mesocyclone, a massive column of swirling air that gives birth to most tornadoes. The mesocyclone in turn is part of an even bigger supercell, a thunderstorm with a low cloud base and powerful and persistent updrafts. A supercell can be 10 to 20 miles across and 60,000 feet high—twice the height of Mount Everest—a scale that makes the actual tornado seem like no more than an energetic tail.

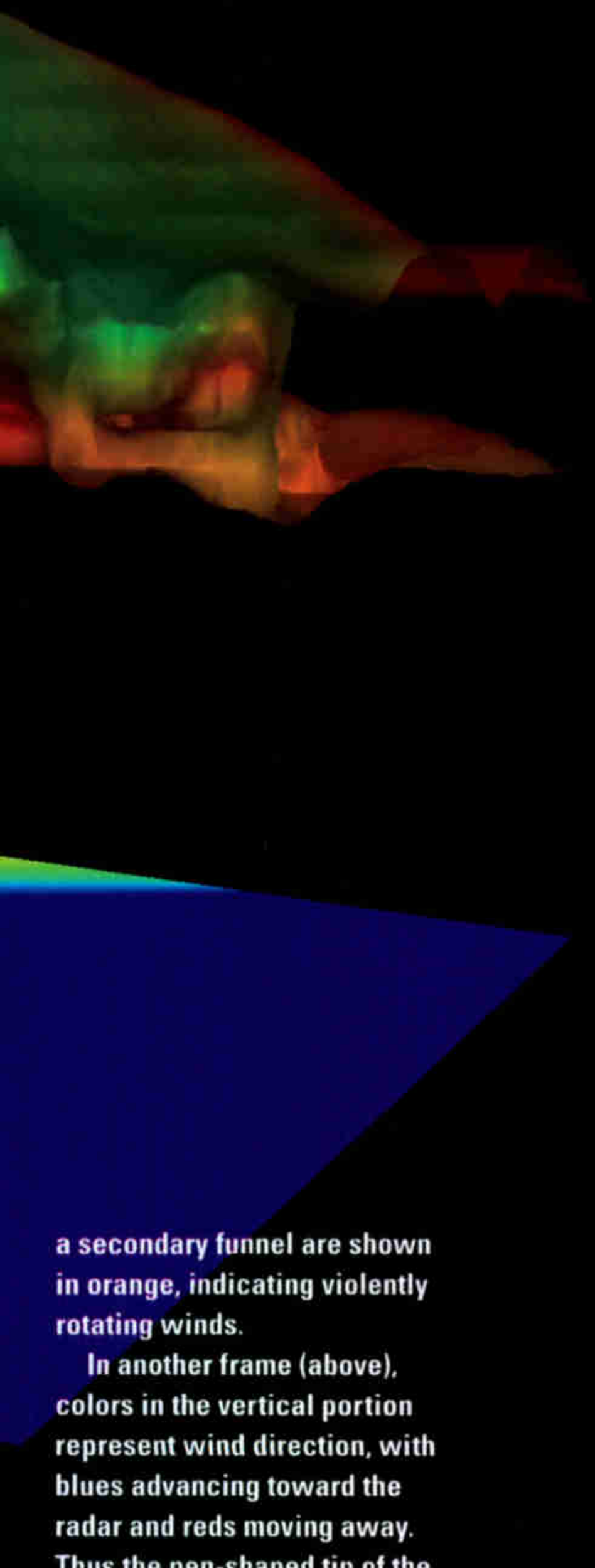
While some meteorologists pursue thunderstorms on the road, others work at computers to make the invisible forces behind tornadoes visible. By simulating tornadoes, scientists hope to learn how to predict the strength and timing of real storms.





TWISTER-IN-A-BOX

Given the right conditions, tornadoes happen. NOAA meteorologist Louis Wicker loaded a sophisticated computer model with weather data from a 25-kilometer-high column of air near Manchester and watched the program build a supercell and tornado very similar to the actual one. One frame of his animation (left) depicts a towering supercell some 16 kilometers high, its cumulonimbus clouds breaking through the storm's classic anvil-shaped top into the stratosphere. The cloud forms are based on *radar pulses reflected* off rain drops or hail. The tornado and

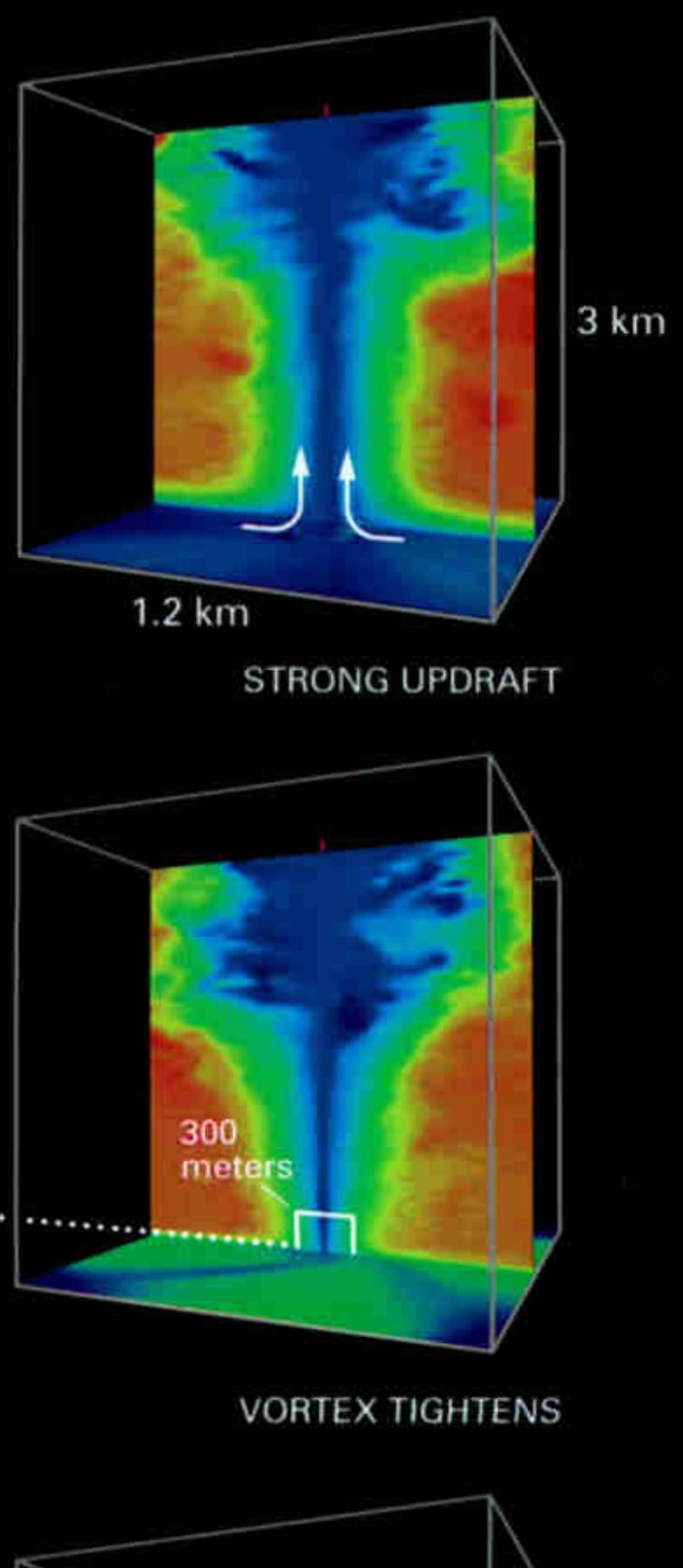


a secondary funnel are shown in orange, indicating violently rotating winds.

In another frame (above), colors in the vertical portion represent wind direction, with blues advancing toward the radar and reds moving away. Thus the pen-shaped tip of the funnel has one red side and one blue, a clear indication of rotation. On the flat plane representing the ground, colors show precipitation intensity, with red most intense and blue least. The tornado makes contact with the ground in the eye of a tightly rotating wind formation called a hook.

DOWN TO EARTH ANSWERS

Tornadoes swirl high into the sky, but winds close to the ground appear to play a vital role in their birth. A computer simulation by Steve and David Lewellen of West Virginia University depicts a cross section of a mesocyclone as it pulls in warm, humid air from the surrounding land and propels it aloft through a powerful updraft (right). As long as surface winds feeding the updraft flow freely, no funnel develops. But if those winds are cut off—by a cold downdraft, for example—the surrounding mass of spinning air contracts and gains speed, producing a tornado (middle). The more the vortex tightens, the faster the tornado spins—just as an ice skater spins faster by pulling her arms in close to her body. Low air pressure near the surface, however, can reverse the flow of air in the core—the strong updraft becomes a downdraft (bottom)—ultimately unraveling the tornado.



FASTER THAN SOUND?

Bright red in the image above indicates the area of the vortex with the greatest speed. Computer models predict that under certain conditions winds near the surface could exceed the speed of sound.

TORNADO SYSTEM DATA PROVIDED BY LOUIS WICKER, NOAA/NATIONAL SEVERE STORMS LABORATORY; ROBERT WILHELMSON, NATIONAL CENTER FOR SUPERCOMPUTING APPLICATIONS, UNIVERSITY OF ILLINOIS AT URBANA CHAMPAIGN (UIUC); MATTHEW GILMORE, UIUC. FUNNEL DYNAMICS DATA PROVIDED BY DAVID LEWELLEN AND W. S. LEWELLEN, WEST VIRGINIA UNIVERSITY
NGM ART

After turning Manchester to rubble, the tornado roars across the prairie, snapping power poles and panicking cows. What look like specks are actually building panels, doors, and other airborne debris. The sound of it, says photographer Carsten Peter, "is a blend of all the crashing buildings and splintering power poles into a smooth, rushing noise like a jet engine."



DEADLY FORCE

The home wrecker was here, flattening this South Dakota farmhouse with winds that impaled a tree with a coat hanger and shelf bracket (left). On the horizon another funnel steals from the crime scene. Says Rex Geyer, who lost his home, "We're here, we weren't injured, and I keep hearing the phrase, 'Geez, you're awfully lucky.' But sometimes it's kind of hard to see where the luck's at."

(Continued from page 25) crouching in a bathtub. A neighbor was literally sucked through the wall of his trailer home. The building toppled over on him, but the storm quickly whisked it off into the sky, leaving him dazed but alive.

But the turtle probes are there, and the tornado has passed directly over two of them. "It hit one probe and moved north into the cornfield," says Tim. "Then it came back and crossed the road again."

"Amazing! Amazing!" shouts Carsten, leaping around the road.

No one sleeps that night, and as word gets out to the tight-knit chase community, the Internet crackles with congratulations. At first Carsten couldn't find Tinman, but the next day he tracks it 160 yards across the fields, where the wind has tumbled it end over end, leaving a trail of great gashes in the soil. It sits poking out of the mud, its glass portholes smashed, looking like a piece of airline-accident debris. The still cameras fired only a few frames before being destroyed, but those images are probably the closest ever taken of a tornado (page 28). Carsten flies out on June 26. In the final hour he has looked deep into the eye of the beast.

Meteorologists respond immediately. Erik Rasmussen casts around on the Internet for other chasers who have photographed or videotaped the Manchester tornado and heads up to South Dakota. Putting tapes together with Tim's measurements from the probes, he may be able to construct a computer visualization of the tornado in action. And examination of Manchester's well-documented demolishment could provide insight into the dynamics of the winds, and how they topple structures.

On July 19 healthy twin girls are born to

The Manchester storm yields



the Geyers—Hayley and Heather, nicknamed "Twister" and "Stormy" by the local media. Rex struggles with insurance claims and leans on his extended family for help.

The Manchester storm yields some of the most startling measurements ever obtained. One probe registers a drop in barometric pressure of 100 millibars, an astounding measurement that verifies theoretical calculations. Computer models predict that pressure drop is an indicator of wind speed inside the tornado, so this reading will help solve one of the great unknowns: How fast are the winds in the core of a tornado?

"Tim's measurements are some of the best ever made," says Rasmussen. "He's the first to measure everything—temperature, humidity, wind speed and direction of a tornado. The data collected will be a gold mine."

Sometimes you get the bear.

WEBSITE EXCLUSIVE See video footage shot in the shadow of a tornado, and hear storm chaser Tim Samaras and photographer Carsten Peter describe the thrill and terror of that close encounter at **nationalgeographic.com/magazine/0404**.

some of the most startling measurements ever obtained.





In the Manchester rubble, rescue workers find a reminder that tornadoes have long been a fact of life in the region. Tornadoes do 400 million dollars in damage each year in the U.S. alone. No one can stop them, but with the help of scientists and storm chasers like Tim Samaras, meteorologists are closing in on understanding tornado dynamics, which will lead to earlier warnings. □



VINCENT MUNIER

By JENNIFER ACKERMAN

"NO MERE BIRD"

CRANES

On Hokkaido, Japan, a yearling red-crowned crane leaps and flares its wings in a dance of either courtship or aggression. The tallest and most elegant of flying birds, cranes are beloved for their grace and beauty—and for their arduous, long-distance migrations.

A radiance of sandhill cranes amasses at sunset over Nebraska's Platte River. More than half a million sandhills pass through this staging area on their spring migration to distant breeding grounds in the far north—creating one of the world's great wildlife spectacles.

JOEL SARTORE

With aerodynamic grace, a young Eurasian crane drifts over the plains of southwest France on its way from Russia to Spain. Cranes may fly more than 30 miles an hour during flapping flight, but prefer to conserve energy by soaring on thermals.

JEAN PATRICK DEYA, GALATÉE FILMS





From a blind overlooking the wetlands of central Wisconsin, I can see a long-legged bird in the distance, a stroke of white curled at the top, like a bright question mark against the emerald green grasses. Then up pops another from the screen of reeds. The birds are yearlings, five feet tall, with snow-white plumage and elegant black wing tips that spread like fingers when they fly. They're quiet now, but from the long trachea coiled in their breastbones may come a wild, singing whoop, harsh and thrilling, that gives their tribe its name.

This would be a primordial scene—big sky, undulations of tall marsh grasses, wild whooping cranes—were it not for a penned area nearby, where several whooper chicks, well camouflaged in tawny feathers, forage in the shallows. In a whisper, crane biologist Richard Urbanek explains that these chicks have been raised in captivity but have never heard a human voice nor seen a human form, except in crane costume. As part of an experimental program to reintroduce a wild migratory population of whooping cranes to the eastern half of North America, these chicks have been fed and tended by crane-costumed people for two months. Now, before they are released to the wild, they are being taught the habits of their ancestors with modern techniques pioneered by Operation Migration, an organization devoted to helping endangered birds learn their traditional migratory routes. Near the pen is a long stretch of open grass, a runway, where the chicks are learning to fly behind

an ultralight plane flown by a pilot in crane costume who will guide them from this refuge 1,200 miles south across seven states to wintering grounds in Florida.

Two cohorts have already made such trips—and returned on their own, the first whooping cranes in perhaps more than a century to fly freely over the eastern United States. After three years of ultralight-led migrations, the new eastern migratory population numbers 36 birds, including the yearlings and the chicks. The success of this effort is leading the way for a more ambitious project half a world away in the northern reaches of Russia. In the fall of next year an international team plans to lead a flock of young captive-bred Siberian cranes along part of their traditional migratory route, from Russia to Iran, to restore the birds' knowledge of the ancient flyway—not with ultralights but with hang gliders that will soar a difficult path extending more than 3,000 miles over four different countries.

These human-guided migratory flights are among the most recent acts of vigorous

Hang glider pilot Angelo d'Arrigo leads a trio of young captive-bred Siberian cranes on a trial flight over the Arctic Circle in Siberia—part of an ambitious effort to teach the endangered birds the migration route of their ancestors from Russia to Iran.



WATCH CRANES MIGRATE LIVE ON THE WEB Each spring more than half a million sandhill cranes converge on Nebraska's Platte River. The sights and sounds of these creatures—the magnificent crane dance, their varied calls, the thrilling vision of thousands in flight—can be experienced in real time via a live camera set up by National Geographic and the Rowe Sanctuary in the midst of the migration grounds. • A website including video, audio, a photo gallery, and an interactive forum board with Rowe Sanctuary biologists will be up this spring. The live action should peak in late March. The cranes start leaving in early to mid-April. See them at **nationalgeographic.com/magazine/cranecam.**

NATASHA PUSTOVIT

Crane conservation status

- **C** Critically endangered
- **E** Endangered
- **V** Vulnerable
- **N** Near threatened
- **L** Least concern
- ✓ Migration route to wintering area
- ◇ Breeding, staging, or wintering area for multiple species

Corresponding colors represent ranges.



Whooping E

Rarest of cranes, the whooping crane once ranged across North America east of the Rockies. Two small populations now migrate between nesting grounds in Canada and Wisconsin and winter territory in Texas and Florida.





Sandhill L

Black Crowned N

Wattled V



Blue V

The magnificent blue crane, national bird of South Africa, migrates vertically from breeding grounds in dry, open grasslands as high as 6,000 feet down to wintering terrain in lower valleys.

The WORLD of CRANES

Truly global citizens, the world's 15 species of cranes range freely over five continents and migrate across deserts, mountains, frozen tundra, and the borders of dozens of nations. As such, they are ambassadors for peace *among diverse* peoples who unite in efforts to save the elegant birds, and for the preservation of their fragile wetland and grassland homes and migratory staging grounds. Because of habitat loss and development, many species that once thrived in much broader ranges —among them, the red-crowned, black crowned, and white-naped—are now restricted to fragments of protected land in parks, sanctuaries, even disputed areas between hostile nations.

SOURCES: THE CRANES: STATUS SURVEY AND CONSERVATION ACTION PLAN. IUCN, GLAND, SWITZERLAND, AND CAMBRIDGE, UNITED KINGDOM; *2003 IUCN RED LIST OF THREATENED SPECIES*

ART BY ROBERT BATEMAN

NATIONAL GEOGRAPHIC MAPS





The most far-flung of cranes, the Siberian nests in wetlands near the Arctic Circle, then journeys south over vast stretches of inhospitable terrain and six different nations to its wintering grounds in China and Iran —a trip of more than 3,000 miles.















High-flying demoiselles can reach altitudes of 24,000 feet in crossing the Hindu Kush during their fall and spring migrations between nesting grounds in Central Asia and the warmer winter territories of India.



SIBERIA
RUSSIA
Uvat
Siberian crane recovery project route
ASTRAKHAN NATURE RESERVE
Volga
GERMANY
EUROPE
KAZAKHSTAN
ASIA
MONGOLIA
Hokkaido
Caspian Sea
AZERB.
Fereydun Kenar
Esbaran Marsh
IRAN
Hindu Kush
CHINA
SOUTH KOREA
JAPAN
Hiroshima
TIBET
Great Indian Desert
TAIWAN
INDIA
AFRICA
KENYA
SOUTH AFRICA
AUSTRALIA



GALEN ROWELL, MOUNTAIN LIGHT

Silhouetted against the high mountains of Tibet, the hardy black-necked crane inhabits remote regions as high as 16,000 feet. The last species of cranes discovered, the black-necked is revered as a spiritual creature by the Tibetans.

intervention to rescue from extinction a singular creature—what conservationist Aldo Leopold called "no mere bird" but "wildness incarnate." For thousands of years cranes have been honored for their beauty, their ancient ancestry, impressive size and flight. In Africa and Europe their image appears in prehistoric art. They figure on Egyptian tombs, in Russian songs, in the totems and clans of Native Americans, in Australian dances, and Greek and Roman myths. In many parts of Asia cranes are held sacred as symbols of happiness, good luck, long life, peace. After the dropping of the bomb that people said was brighter than a thousand suns, a young girl stricken with radiation sickness set out to fold a thousand paper cranes in the hopes that she would recover. She died before reaching her goal, but other children pursued the task, and now the stone monuments of Peace Memorial Park in Hiroshima are ornamented with millions of the tiny folded cranes.

Cranes figure on Egyptian tombs, in Russian songs, in the clans of Native Americans, in Australian dances, and Greek and Roman myths.

The esteem in which these birds are held has not spared them destruction. Cranes are among the most endangered families of birds, having been hunted, persecuted, chivied out of their last havens by human pressures. Nine of the planet's 15 species are threatened with extinction. In East Asia loss of wetlands threatens the red-crowned, the hooded, and the



BERNARD CASTELEIN

Known as the lovely birds by the people of Mongolia, demoiselle cranes rest on the dunes of the Great Indian Desert at their wintering grounds in western Rajasthan, India. The diminutive demoiselles are among the most widespread of cranes, nesting across the steppes of Eurasia.

white-naped cranes. The graceful blue crane, the national bird of South Africa, has suffered from predation by wild dogs and the cultivation of tree plantations, which has eliminated great stretches of its unique grassland habitat.

Whoopers, the rarest of cranes, were extirpated from much of their range in North America in the 19th century by hunting, egg collecting, and habitat destruction as settlers drained wetlands and plowed prairie for farming. By the early 1940s only 21 birds remained. The extreme plight of the whooping crane alerted many people to the high price we may pay for harming the natural world—and the need for extraordinary efforts to recover what is almost lost. With the help of habitat protection, hunting restrictions, and captive-breeding programs begun in the 1960s, the remnant population of whooping cranes began to grow. It now numbers 300 birds in the wild and more than 100 in captivity—not anywhere near its original abundance, but a big step on the road to recovery.

One man who has led the strenuous work to save the whooping crane is George Archibald, co-founder of the International Crane Foundation (ICF) in Baraboo, Wisconsin. Now Archibald has a new dream. In a patch of prairie spangled with blooms of butterfly milkweed and *Silphium* not far from the headquarters of the ICF, Archibald sits in the same dark shack where Aldo Leopold wrote his classic essays on conservation. A self-described "craniac," Archibald is considered the world's foremost expert on cranes. He is an unassuming man, committed to rescuing cranes from the abyss of extinction, and forever optimistic

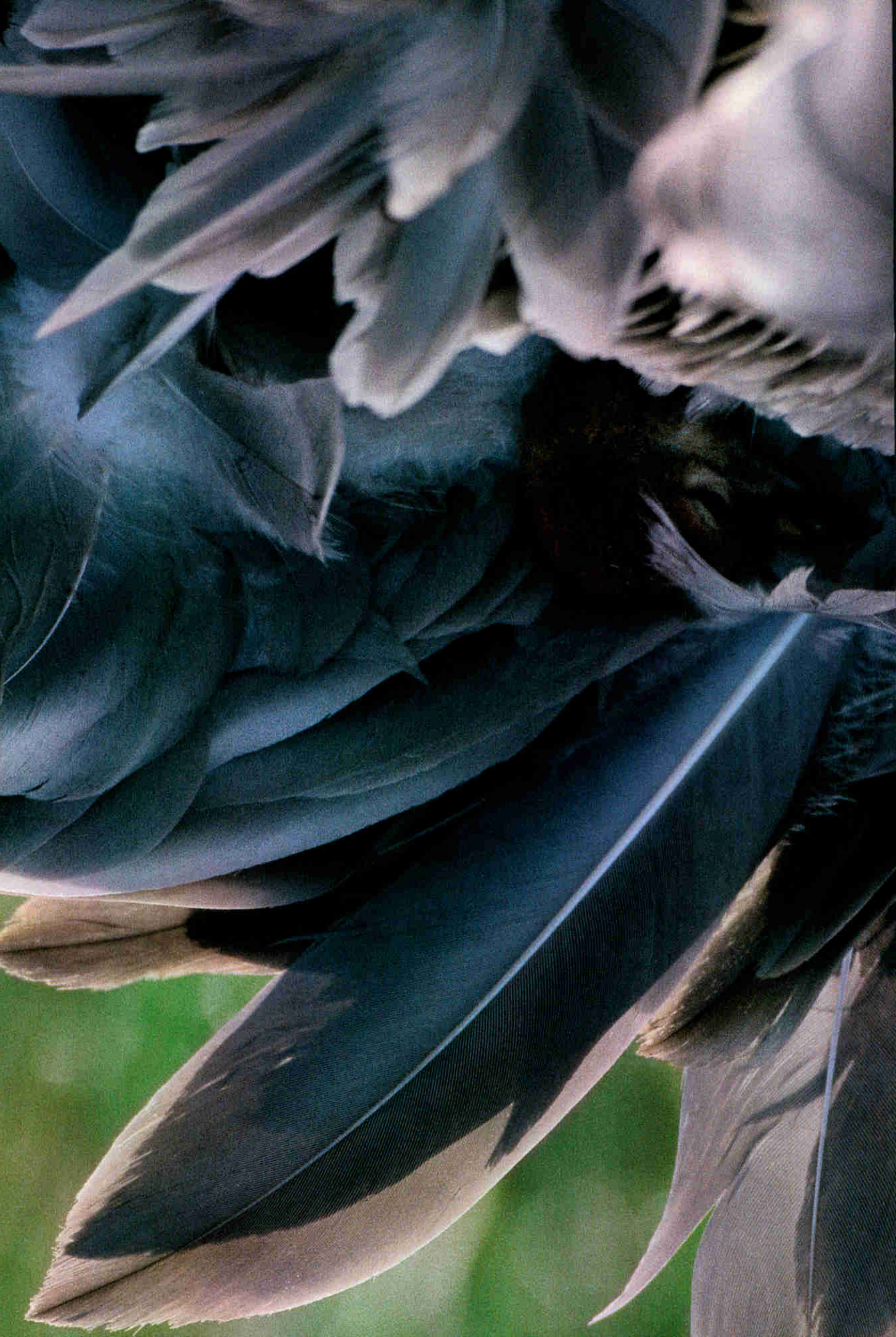


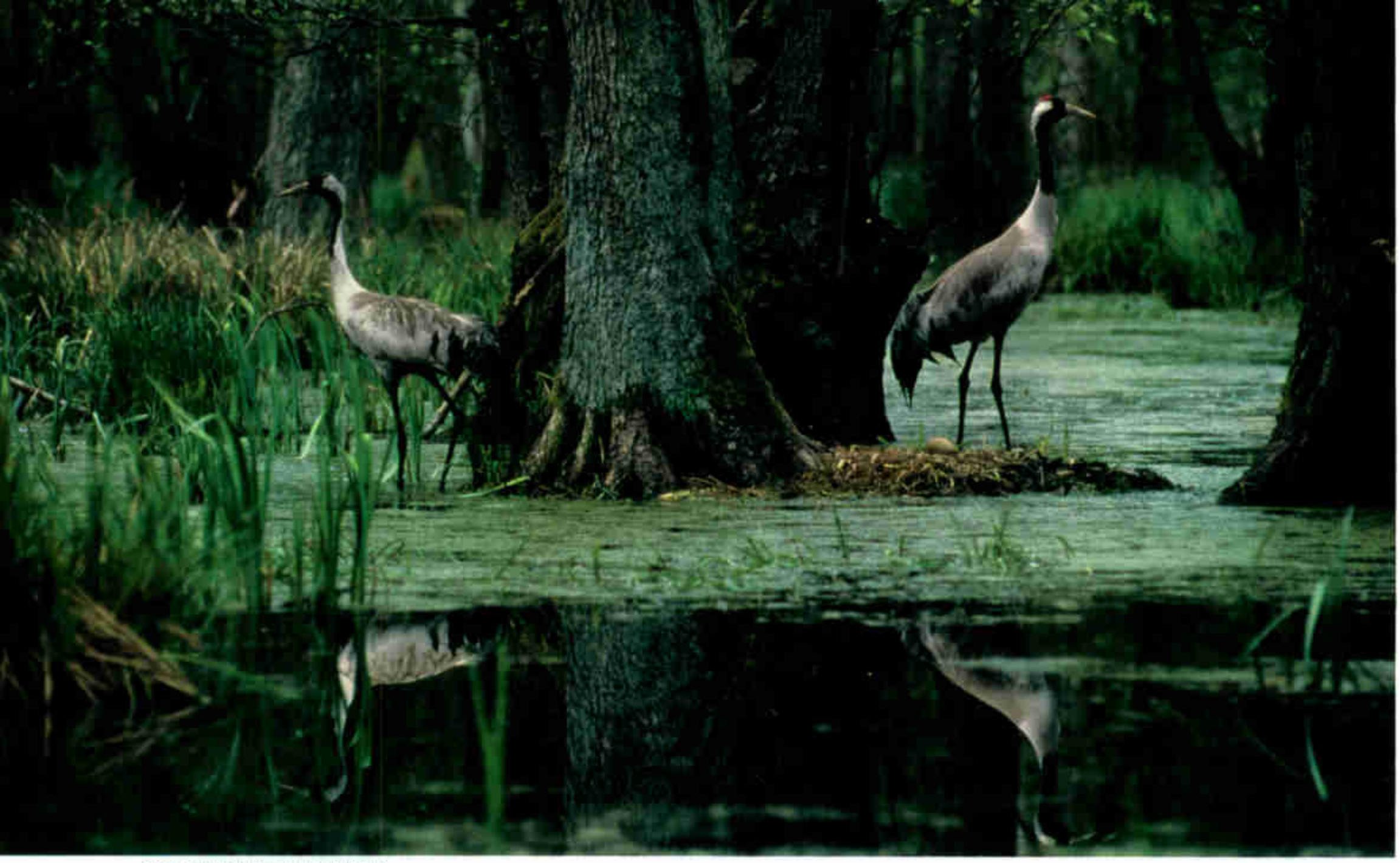
Sandhill cranes roost by the thousands in the shallow waters of the Platte River. The flocks will spend more than a month here gorging on waste corn in surrounding fields to fuel their long journey to breeding grounds as far north as northern Canada.

TOM AND PAT LEESON

On a nest in central Florida a sandhill crane warms its chick against the gusty winds of a cold front. Most cranes lay just two eggs each year, and only one chick usually survives. This low reproductive rate slows recovery from population losses.

MICHAEL FORSBERG





CARL-ALBRECHT VON TREUENFELS

A pair of Eurasian cranes guards its nest in an alder bog in northern Germany. Though Eurasians prefer nesting in such large, isolated bogs and swamps, these habitats are dwindling, so the cranes often make do with pocket wetlands in cultivated regions.

about his chances for success. In the past quarter century he has helped to launch crane conservation programs in Japan, China, South Korea, India, Iran, South Africa, Australia, and Russia. He and his team at ICF have created a species bank of captive cranes to guard against extinction. He has carried crane eggs tens of thousands of miles in plywood boxes and delivered them safely to captive-breeding facilities. He has danced with cranes, sung with them, devoted his life to saving them and their habitat.

Why? "Cranes are ambassadors of the ecosystems in which they live and also of international goodwill," he says, "two things we need to conserve. Because these birds require pristine habitat, they act as umbrella species; if you save them, you are also saving the wetland and grassland ecosystems on which they depend. And because their migratory routes don't heed political boundaries, any effort to protect them requires the participation of diverse people in different countries. So they act as vehicles for cooperation between nations that are often politically polarized." He pauses. "Also, I love them."

Archibald's latest goal is to restore a population of migratory Siberian cranes to Central Asia. Sometimes called snow wreaths, the magnificent Siberians are the most highly specialized of cranes, depending exclusively on bogs, marshes, and other wetlands for nesting, feeding, and roosting. They are also the most critically endangered, their numbers dwindling from loss of habitat and from hunting during migrations. The Siberians have traditionally migrated more than 3,000 miles from the high tundra of Siberia across 11 countries



THOMAS D. MANGELSEN, IMAGES OF NATURE

In the marshy woodlands of Kenya, a quintet of grey crowned cranes perches on the limbs of an acacia tree. One of only two crane species that roost in trees, the grey crowned has become a powerful symbol for the conservation of wetlands in East Africa.

to wintering grounds in China, India, and Iran. The success of the migration depends on the welfare of chains of wetlands across the continent, which serve as stopover points for the birds.

Archibald and an international team are working to secure legislation safeguarding these areas and upgrading their protection. The effort takes patience, as many of these nations are dealing with difficult political situations, limited resources, and skeptical leaders.

In the summer of 2005 the team plans to raise a dozen Siberian chicks in captivity with crane-costumed parents and train them to fly behind hang gliders flown by crane-costumed pilots. Then, sometime that autumn, three hang gliders will launch from Uvat, Russia, soar over western Kazakhstan, stopping at the Volga River's Astrakhan Nature Reserve, then wing south over Azerbaijan, along the western shore of the Caspian Sea, to the flooded fields at Fereydun Kenar and Esbaran, the cranes' wintering grounds in Iran. The birds will follow.

> Cranes are among the most endangered families of birds, having been hunted, persecuted, chivied out of their last havens by human pressures.

The international effort to find these birds safe passage in such politically troubled areas is considered crazy by some and brilliant by others, a way of drawing global attention to the cranes and their world—minnow, bulrush, cattail, river shallow, aura of ancient flyways that unite regions and ignore borders.



The quiet waters of the Platte River draw a squadron of sandhills to roost overnight—as they have for millennia. When we hear the call of the crane, wrote Aldo Leopold, "we hear the trumpet in the orchestra of evolution . . . the symbol of our untamable past." □

MICHAEL FORSBERG



UNEASY EMBRACE
An ex-beauty queen kisses an inmate's son during a fund-raiser for a program that lets mothers in Johannesburg's Diepkloof Prison live with their children.

CITY OF HOPE CITY OF FEAR

JOHANNESBURG

BUILT ON GOLD MORE THAN A CENTURY AGO, JOHANNESBURG IS STILL A MONEY MACHINE. BUT TEN YEARS AFTER THE COLLAPSE OF APARTHEID, SOUTH AFRICA'S BOOMTOWN ALSO REMAINS A VIOLENT, DIVIDED CITY.

BY PETER GODWIN PHOTOGRAPHS BY TOMASZ TOMASZEWSKI

Searching for a cappuccino bar in Soweto, Johannesburg's sprawling black township, might seem like a fool's errand, but Jerry Marobyane, my guide, insists that it's around here somewhere. We cruise slowly along the rutted roads, past hundreds of makeshift shacks interspersed with smoking garbage heaps, past rows of "elephant" houses, their dun-colored concrete roofs curving down to the ground like the thick, crinkled hide of an elephant.



Of the foamy icon of the comfortable classes there is no sign, until, with a cry of triumph, Jerry spots it. But something is wrong—Soweto Cappuccino has been replaced by 21st Century Funerals. Inside, the receptionist, Mpho Dilwane, tells us that the cappuccino experiment was a failure. Because of the AIDS epidemic, she says, the death business is flourishing. Avalon, Soweto's huge cemetery nearby, now holds 210 burials a week.

As we drive away, Jerry explains how the coffee bar had sprung up as white rule of South Africa sputtered to an end ten years ago this month. The bar catered not to Soweto's residents but to the busloads of tourists that passed through on whistle-stop excursions to this township that had become symbolic of the whole struggle against apartheid. The tourists came to pay homage at Nelson Mandela's old house. They came to see the former residence of Archbishop Desmond Tutu, the fearless prelate who thought nothing of striding into a baying crowd to rescue a suspected police informer from being "necklaced"—garlanded with a burning tire. They came, too, to see the place where black schoolchildren, protesting that their classes were to be taught in Afrikaans, were gunned down by police.

Under Mandela's charmed guidance, South Africa began the post-apartheid period as a country beguiled by its own miraculous stepping back from the brink of a full-blown race war. It dubbed itself the "rainbow nation" in recognition of the new spirit of tolerance and inclusion that most South Africans hoped would replace the old one of bigotry and fear. The bar was particularly high for Jo'burg (as it's usually shortened), the country's most diverse city. Freed from the constraints of political isolation, the city could live up to its new motto: "World Class African City." South Africa was to be the vehicle for the African renaissance, a sort of postcolonial, post-Cold War, postapartheid new beginning that would herald an Asian tigerlike economic leap, with Jo'burg as its launching pad.

Today, a decade after the birth of the rainbow nation, the urban expanse of Johannesburg and its satellite cities is home to more than eight million people. Together they generate 9 percent of the economic activity of the entire African continent, and they enjoy a standard of living way above the African norm. Yet they also endure one of the continent's highest rates of violent crime, albeit one that seems now to be decreasing.

In those early days after apartheid, when sanctions against South Africa were finally lifted, it was from Johannesburg that battalions of South African businessmen (most of them white) reached up into the African interior, aggressively pursuing opportunities in countries regarded as too perilous by most Western investors. They took over breweries in Mozambique, Tanzania, Malawi. They won cell phone network contracts in Nigeria and the Democratic Republic of the Congo. Across the continent they set up supermarket chains, refurbished shabby hotels, and established banks. Soon the departures board at Johannesburg International Airport read like an African geography lesson.

Meyer Kahn, as chairman of South African





FOR LEASE **Once filled with white-owned businesses, high-rises downtown now beg for tenants. In the 1970s businesses began moving to the suburbs. Later, blacks came into the city center. In the 1990s landlords neglected their properties, investors pulled out, and many whites left.**

Breweries (now SAB Miller), one of Johannesburg's flagship corporations, was at the forefront of this commercial invasion of Africa. In his large office on Braamfontein ridge overlooking the city, he is in an expansive mood. "We're not put off by lack of infrastructure or by problems of the Third World consumer," he says. He believes Johannesburg is the one city in Africa that has a competitive edge. "We understand the consumer in the markets in the developing world—within half an hour's drive from this office I can get to Soweto, with its nearly one million throats; half an hour north and I'm at the rich, sophisticated market in Sandton that can make New York's Fifth Avenue look ordinary. And, most important," he says gleefully, "within half an hour of my desk there are 15 golf courses that would rate among the top in the world."

Jo'burg has always been a swaggering, overbearing place, too big for its own hinterland, a place that operates on First World time, self-absorbed and unforgiving. And at an elevation of nearly 6,000 feet, there is, as the writer Doris Lessing once observed, something about its "dry and nervous air" that makes the heart beat faster.

And yet, Kahn points out, Johannesburg's growth into Africa's premier city was far from smooth, with frequent boom-bust cycles. "Over



SWEET SUCCESS Sharing tea with a colleague at her Johannesburg home, TV talk show host Felicia Mabuza-Suttle, at right, scans a magazine story about her career. Apartheid cost her grandparents their house and family businesses when the government designated their neighborhood all white in the 1950s. It also led Mabuza-Suttle to immigrate to the United States in the 1970s.

Since apartheid ended, she has left her husband and two daughters in Atlanta for long periods to help build a new South Africa. At first South Africans were reluctant to talk to each other on TV, but Mabuza-Suttle's show has broken down barriers. "There was a dire need for a forum for people who had been silenced for so long to speak openly," she writes. "Dialogue is therapeutic."

the years we've had floods, plague, boycotts, strikes, political violence; we've had apartheid, international sanctions, absurd peaks and valleys of economic growth. But we've survived because we have a First World infrastructure, a vibrant corporate sector, and a remarkably resilient people—black and white."

"OH LORD, YOU'VE GIVEN US OUR FREEDOM, NOW HELP US TO HOLD ON TO OUR DREAMS."

—PRAYER AT A CITY HOMELESS SHELTER

It's not just the corporate behemoths that provide the economic muscle; there is also a booming informal economy fed by small-scale, cash-only street traders, largely missed in official statistics. "You can still hustle a living here," says Kahn. "If you took this chair outside onto the street and got a pair of scissors and a towel, you could immediately start making money as a barber. The dynamism and the sheer size of the market creates all sorts of opportunities for anyone with any initiative. There's a special drive in this city. That's why people gravitate towards us from all over the continent and beyond."

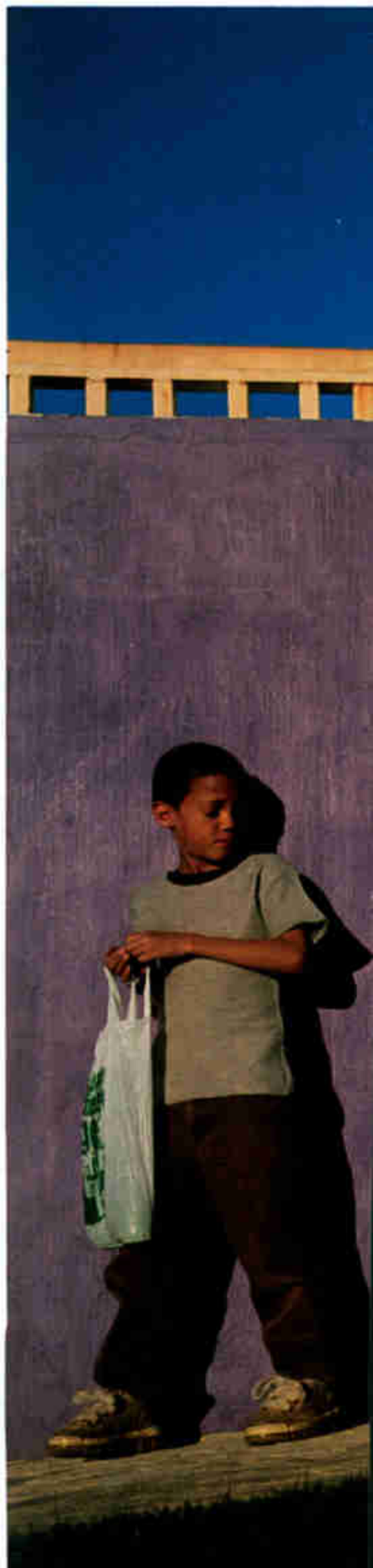
The siren call of one of sub-Saharan Africa's biggest cities carried all the way to Malawi—1,100 miles to the north—where it was heard by Oliver Nkhoma and his younger brother Ken. "When I first saw this place, I thought I was dreaming," remembers Oliver wistfully. "Big mansions and skyscrapers, tunnels and highway overpasses, all these different languages being spoken, fast trains rushing by." He, Ken, and several other Malawians run a market stall selling mahogany and ebony masks and carvings of wild animals. They take turns making the 30-hour bus ride home to collect new supplies. Every time they go back, each takes a TV set, a radio, clothes, and shoes to resell there. "It is very poor at home," says Ken. "Jo'burg is where the money is—we can make a much better living down here." The Zimbabweans, Congolese, and Nigerians from the neighboring stalls, who have gathered around, raucously agree.

Johannesburg has also become the haven of choice for a cosmopolitan black African elite, the so-called waBenzi, after their once favored make of car. Cabinet ministers and entrepreneurs come here from all over Africa to dine in the continent's best restaurants or to be healed in the city's world-class hospitals. They enroll their children in its exclusive private schools, and they buy mansions from emigrating whites.

The city council, hoping to capitalize on Jo'burg's magnetism, proclaims it "an African city that works." But the boast applies fully to only part of Johannesburg—the former white suburbs such as Sandton, Houghton, and Rosebank. For many of the 74 percent of the population who are black, living conditions remain harsh and often violent. The mingling of great swells of hope and pits of fear has given rise to a quintessentially Johannesburg state of mind, one of euphoric despair. It was summed up poignantly by Judy Bassingthwaighte, who was organizing a feeding program for the homeless in the city center. Leading her volunteers in prayer, she said, "Oh Lord, you've given us our freedom, now help us to hold on to our dreams."

If Johannesburg is to live up to its potential, it must overcome its apartheid legacy of division, a legacy that has distorted its development and warped its identity. Contact between races often remains stilted as people get to know one another on a more equal footing for the first time. The hope is that with more children mixing at school, the next generation will coexist more easily.

Crime is the one overriding concern all races in Johannesburg have in common. Comparative statistics are difficult to come by, because in July 2000 the government stopped issuing crime figures—only to resume releasing them a year later with different categories, a move critics charge was designed to blur bad news. The headlines, however, remain stark: In the worst parts of the city nearly one in three people were robbed last year. Murder for the greater metro area runs



at 60 per 100,000—three times the rate in Chicago, America's most dangerous city. Johannesburg experienced 20,173 incidents of burglary on residential premises last year, and businesses cite crime as a "major obstacle to growth." Fewer tourists now come to Johannesburg proper, heading instead straight to game parks or the seaside.

Crime waves are not new to Johannesburg. Almost since its very beginning in 1886 when an Australian prospector, George Harrison, stumbled upon a rock richly veined with gold, it has been a dangerous place. Barely had the city been born than a city father of rival Cape Town (no doubt stung by Jo'burg's prodigious growth) condemned it as a "university of crime." Harrison's discovery proved to be part of the Witwatersrand, "ridge of white waters," a thick reef of ore 60 miles long—the richest seam of gold the world has ever known. At its center a "public diggings" was set up and named Johannesburg, after its surveyor. But to the black migrants who were recruited from villages across the country and beyond its borders to toil in the mines, it has always been eGoli—the City of Gold.

Fortune hunters converged from Britain, continental Europe, Australia, and America—*uitlanders,* foreigners, the Boers called them—and Johannesburg soon had all the bombastic energy of the Wild West. It almost universally appalled those who saw it. "It is a city of unbridled squander and unfathomable squalor," wrote one early visitor. Winston Churchill, then a young foreign correspondent, *(Continued on page 70)*

BREAKING OUT **Middle-class children emerge from their walled homes for a rare bit of play on the street. Dreading crime, many people live in fortress-like compounds. Says one resident, "When I come back from work, I close the door and do not go out."**





HIRED GUN Armed and dangerous, a guard stands watch over a shop in Johannesburg. Faced with some of the highest rates of robbery (72 a day) and theft (227 a day) in the world, most store owners employ a guard. The violence of the apartheid era and present-day poverty and inequality fuel lawlessness. Frustrated by the failure of police and courts to keep them



safe, residents sometimes turn into vigilantes. "When the police get on the scene, we find suspects beaten up," says an officer in one of Johannesburg's rougher neighborhoods. "People want to hurt the guy, because they feel he will be on the street again." Streets in the city center are a bit safer these days: New surveillance cameras are beginning to cut crime.

BEHIND THE WALLS

Secure in Westcliff, a community patrolled by private police, financial consultant Sandy Herman (right, at center) starts each day with breakfast on the lawn before retiring to his home office, far from the crime and grime of the city center. After 25 years in Johannesburg, Herman has never seen Soweto, the city's largest black township, but he now counts blacks among his neighbors, friends, and business associates. "Apartheid seems like a long-forgotten nightmare," he says. Elsewhere in the affluent north, a third of the student body at the exclusive King Edward VII School is now black—the result of a rapidly expanding middle class—but generally it's white students who choose to study Afrikaans (below). People of all races mix at the upscale Sandton Square mall, effectively a suburban downtown, where a groomer primps a poodle for a dog show (opposite).





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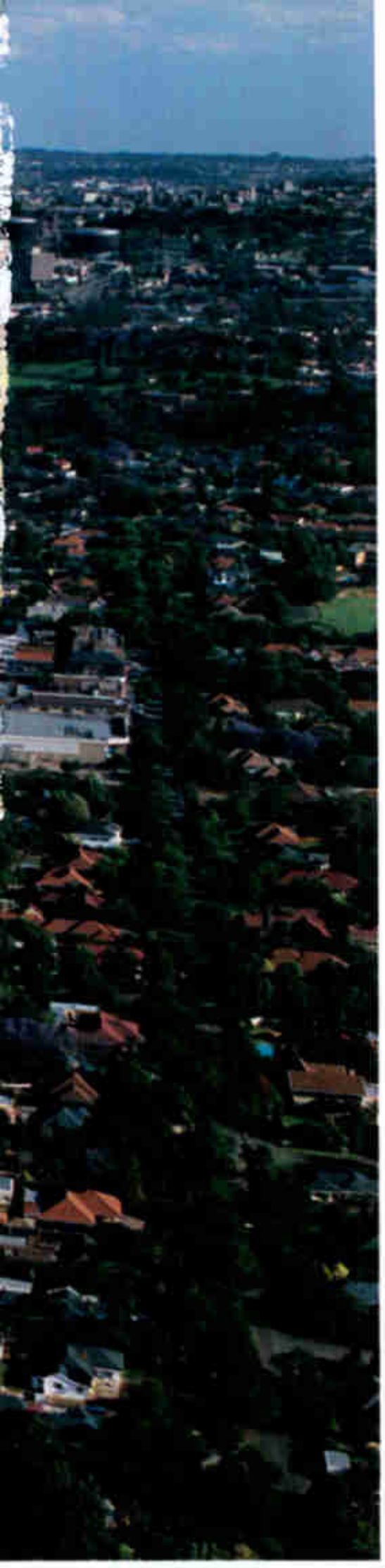


EDGE CITY **East of Johannesburg's core, red-roofed villas house well-to-do whites. Making up 53 percent of the city's residents before the end of apartheid, whites now form just 16 percent of its 3.2 million people. Their numbers continue to fall as blacks seeking scarce jobs crowd formerly white neighborhoods.**

thought it "Monte Carlo superimposed upon Sodom and Gomorrah."

The businessmen who financed the mines and grew rich upon their precious ore were called Rand Lords (the "rand" referring to Witwatersrand). They built stone mansions along the ridges and hillsides and planted their gardens with exotic trees: jacarandas from the West Indies, oaks and chestnuts from England, blue gums and flame trees from Australia. Today as you fly into Johannesburg International Airport, you see a dense canopy of irrigated green, through which wink the pristine swimming pools and lush shaved lawns of the northern suburbs. The plane banks into its final approach, and suddenly you're over Soweto, a constellation of 39 neighborhoods originally named the South Western Townships. They were established in 1904 (after bubonic plague broke out in Jo'burg's slums), ten miles from the city center—downwind of the huge piles of tailings that rose like yellow pyramids alongside the mines.

Much of that gold is now exhausted, and Jo'burg has long since reinvented itself as the commercial and financial capital of Africa. These are less labor-hungry pursuits, mostly requiring skilled and literate workers, and so the days are over when all you needed to get a job here was a good pair of lungs and a willingness to work underground at temperatures well above 100°F.



I was based in Johannesburg as a foreign correspondent in the last half of the 1980s and came often to Soweto to report on the almost daily battles between the police and the black youths seeking to overthrow apartheid. They organized rent strikes and bus boycotts, they stoned the police and were shot at and imprisoned, and they abandoned their schooling with the slogan "liberation before education."

For many of them, freedom has not been kind at all. They don't have the skills to thrive, and they're used to living outside the law. Some call themselves amaGents (an ironic corruption of the word "gentlemen") and have morphed into a kind of nihilistic gangster cult. Unemployment in Soweto is now at 37 percent and rising.

If he hadn't found occasional work as a bodyguard and guide, Jerry Marobyane could easily have been one of the amaGents. He still carries the scars he sustained as a guerrilla fighter for the now governing African National Congress. Then known as Makarov, after his favorite Russian pistol, Jerry tried to toss back a grenade that had been lobbed at him by members of a rival political faction, but it blew up inches from his right hand. That hand is now made of rubber-coated steel, and he has switched his shoulder holster to the other side.

Largely to avoid the specter of violence and the cramped conditions of Soweto, a number of blacks left for the northern suburbs after 1994, when the Group Areas Act, which had mandated segregated residential areas, crumbled. Kgomotso Modise—once a sports administrator who pioneered South Africa's multiracial soccer league and now retired as the chairman of the South African office of the Saatchi & Saatchi advertising agency—moved to the leafy security of Bryanston. Modise, who is in his sixties, relies on a wheelchair because he has a police bullet lodged in his spine—one of seven that wounded him during a protest in Soweto in 1983.

His has been an extraordinary journey: Until 18 years ago the South African Broadcasting Corporation did not even permit blacks and whites to appear in the same commercial. Modise started in advertising by devising campaigns to sell products specifically to blacks, a lucrative market even under apartheid. As white-owned companies woke up to this largely untapped reservoir of customers, they needed people like Modise to help navigate around black cultural and social sensitivities. "The markets differ in all sorts of ways," says Modise. "There was a whole range of products, such as Black Like Me hair products, that were exclusively targeted at blacks. And things like washing powder were introduced far later to black markets, which had been used to blue laundry soap. Today," he adds, "the black middle-class consumers of shoes remain far more sophisticated than their white counterparts."

I ask Modise about his life in the suburbs. "A lot of my friends and peers have moved away from Soweto. But we miss the socializing, we miss the shebeens," he says, referring to the pubs that are at the heart of community life in Soweto. "It can be lonely in the northern suburbs. I don't even know my white neighbors, though I've lived next to them for more than two years." On the weekends Modise and his friends join the convoys of luxury sedans and SUVs filled with other upper middle-class blacks making the pilgrimage back to their favorite shebeens. There they are generally welcomed, though a black class system is fast becoming established here, especially as middle-class black children start to attend former white schools, and the camaraderie of the fight against apartheid dissipates.

Modise has brought his parents with him to the northern suburbs, though they have been dead many years. The Soweto cemeteries are terrible, he says. "People sit on the tombstones and drink beer. They have no respect." So Modise has reburied his parents in a formerly whites-only cemetery near his new home, a ritual complete with cattle sacrifice in his suburban garden to appease his ancestors. "I'm not sure my neighbors here were thrilled by that," he laughs.

Even in his new sanctuary, however, Modise

STRUGGLING IN SOWETO

A woman from Zimbabwe hawks cooking spoons in Soweto, her back turned to a billboard urging township dwellers to put their money in an Afrikaner bank. Soweto symbolizes opportunity for newcomers from poorer African countries, but longtime residents find it harder than ever to earn a living. Nearly 40 percent of its people are unemployed. Most of these are unlikely to find formal work since they lack skills and education and because there are now fewer manufacturing jobs in Johannesburg. So they hustle. One entrepreneur sells repackaged milk for 25 cents a bottle (opposite). Many Soweto women make a long early morning commute downtown where they start charcoal fires (below) to roast peanuts for sale. Raised in Soweto, singer Mandoza entreats township dwellers not to give up: "How are you going to get it, if you don't get up and go for it?"





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DEATH TOLL **Adorned for his funeral, a gunned-down taxi driver is prepared for burial in Soweto, where undertaking is big business because of crime and AIDS. Citywide, a third of pregnant women and one in ten people overall are infected with HIV, while AIDS kills 30,000 a year and has cut life expectancy by 15 years.**

and others like him are not immune to violent crime, which penetrates the high walls and the razor wire, the dogs and the private security patrols. And no crime quivers the lip here more than carjacking, much of which is in the hands of organized syndicates that have made Johannesburg and environs a major carjacking hub, with about 25 incidents a day.

One Thursday in the northern suburbs, Zoe Plein, an insurance consultant, pulled her new white Chrysler Voyager into her driveway at 3:40 p.m. "I remember the time exactly," she says. "My mother was in the back with my kids." Eden, age three, and Noah, seven months old, were strapped into their car seats. "I heard my mother say, 'Oh my God!' and I looked up to see a gun barrel at my window." It was brandished by an immaculately dressed young black man with a shaved head who never said a word throughout. With his gun he motioned her to get out. "You can have whatever you want," she said. "Just let me take my kids out." She and her mother fumbled to unclip the children and got out. Eden saw the gun and began screaming hysterically, "Don't hurt my mummy! Leave us alone!" The man mimed for Zoe to take her rings off, but they were stuck fast. He cocked his pistol in irritation, and she licked her fingers, desperately pulling and twisting the rings until they finally worked loose. The thief and his accomplice took her purse



and cell phone and drove off.

"When my husband arrived, he said, 'That's it! We're leaving!'" (The rest of his family had already settled in Chicago.) "We were both born in Jo'burg; it's a beautiful place, and I don't want to leave it, but is there a future here for our little ones?" Eden was in therapy. "She kept asking, 'Are the baddies coming back?' and I said, 'No, no—they're in jail.' But of course they're not, they were never caught. I feel like we're being forced to go," Zoe grimaces. "It makes me so angry."

The soaring crime rates set off alarms in the city's influential business community, and in March 2001 the executive mayor, Amos Masondo (who had once served time with Nelson Mandela on Robben Island), oversaw the launch of a coordinated effort to seize back the initiative. From the rump of the traffic department a new city police force, the Johannesburg Metro Police Department, was created. This well-equipped force is already 2,500-strong and is expected to expand to 4,000. Masondo sees it as part of a "police visibility campaign" to get more cops out on the streets and free up the regular force to concentrate on serious crime.

At the same time, efforts were also made to crack down on police corruption. In 1999, 4,374 police staffers nationally were under investigation for corruption (out of a total force of 105,556). Although the numbers aren't as striking today (from April 2002 through March 2003, 872 members of the police force were suspended for involvement in corruption), there is still some way to go.

The front line against the city's crime is the Johannesburg Police Flying Squad, based in Brixton Hill above the crenellations of the city's high-rise skyline. Inspector Aboobaker Buckus, tonight's watch commander, briefs his men as they tool up with assault rifles, automatic pistols, bulletproof vests. At the call center the pace is heating up as operators handle emergency calls in most of the country's 11 official languages, all of which are spoken in this city. Buckus—an ethnic Indian—arrived from Natal Province in December 1991 with five buddies to try to make it into this specialized unit. The others quit within the year. Wages are low, and in recent years police casualties have been alarming. (From 2001 to 2002, 45 policemen were killed in the Jo'burg area; in 2000, 62 died—compared with two in New York City, both killed in auto accidents.) Sergeant Jannie Odendaal, an Afrikaner, sits up front, and I share the backseat of the Opel Kadett with a large metal crate of ammo. "We got sick of running out of bullets," says Odendaal.

The night passes in a haze of ultimately futile high-speed pursuits of carjackers and robbers, and as the first traces of dawn bleach the city sky, our final call takes us downtown, to a report of shots heard. We arrive to find a black teen with carefully gelled hair, in a neatly pressed jean jacket and red Converse sneakers, sitting on the sidewalk. He is leaning back against a wall, his eyes closed. Sergeant Odendaal tugs gently at his sleeve to wake him, but the jacket falls open to reveal a large red stain still spreading across the T-shirt beneath. The kid has been shot through the heart. A small knot of onlookers has gathered, but no witnesses come forward. No one seems particularly bothered.

Downtown Johannesburg, where this young man now slumps lifeless, is the middle ground between the First World of the former whites-only suburbs and the Third World of the black townships. Today it is also the focus of the battle to contain crime. Lose the battle, and the city of gold will lose its allure.

From a distance the massed high-rises and monumental Edwardian buildings of the city center are still impressive. But until recently many were boarded up, abandoned in favor of

VIOLENT CRIME PENETRATES THE HIGH WALLS AND THE RAZOR WIRE, THE DOGS AND THE PRIVATE SECURITY PATROLS. AND NO CRIME QUIVERS THE LIP MORE THAN CARJACKING.

suburban office parks by the commercial giants that were headquartered here. In 2000 the Johannesburg Stock Exchange followed its clients north to Sandton. Yet the streets beneath the seemingly empty office blocks of the city center still bustle by day—crammed with vendors hawking fruit and vegetables, plastic shoes and secondhand clothes, to a clientele of black township commuters.

"It's changed, it's changing, but dying it isn't. It's not the apartheid city of the past; it's an African city that reflects the demography of the country," insists Neil Fraser, director of the Central Johannesburg Partnership, an alliance of city and private sector interests that is coordinating the battle to revitalize the downtown economy. Garbage collection is being improved, police patrols boosted, and the unlicensed vendors who choked the streets are being regulated, all in an effort to attract residents and businesses. A web of surveillance cameras now spies on the city center, connected to a complex computer brain known as the matrix, whose operators report directly to the police and to the city managers. John Penberthy, head of the enterprise that runs the system, says street crime downtown has been significantly reduced.

Meanwhile, the South African government, in a major effort to improve the lot of blacks in Johannesburg, is building one of the largest housing projects the world has ever seen, tens of thousands of basic homes with running water and electricity. It's a Sisyphean task: The appeal of eGoli is as strong now as it was to the prospectors more than a century ago, and as fast as new houses are built, more shanties are thrown up by fresh crops of hopeful arrivals.

I visit a shantytown mushrooming on a farm called Bredell near Johannesburg International Airport. Such is the nervousness of foreign investors that the shantytown's appearance had lowered the value of the rand, South Africa's currency. Riot police soon arrive and, as they so often did in the apartheid past, they stand guard over a demolition team: 200 men in red fatigues armed with crowbars—the so-called Red Ants, who wait for the order to destroy the shacks.

Constance Mamatlepa stands at her front door. Upon it is painted a figure of Christ on the cross, complete with a crown of thorns, bloodied ribs, and a serene smile of forgiveness. "We have three choices," she says, surveying the forces arrayed against her. "Tear gas, rubber bullets, or police dogs."



TASTING FREEDOM **Police put a bullet in his spine, but antiapartheid activist Kgomotso Modise, at right, survived to become the head of an ad agency and share a smoke with a friend. He wishes more blacks knew such prosperity: "Economically we are still not liberated. It's going to take a generation or two."**

"They can break down our houses," says Caroline Seema, her neighbor, "but we will just come back later." In the thick mist that shrouds the valley, the Red Ants finally invade, and the air is filled with the gnash of crowbars on metal. As the residents watch their homes collapse, they break into one of the haunting anthems of struggle against apartheid, a song called "Senzenina?"—"What Have We Done?" Their harmonized voices rise briefly up the valley before being drowned by the rotor thump of a police helicopter.

And yet still the new migrants come to Johannesburg, and the question still hangs in the dry nervous air: Can this city help save Africa, uplifting the lives of millions—or will Johannesburg simply be overwhelmed by the needy and the desperate, a woeful harbinger of the chaos to come? It is a weighty responsibility to hang on one city, but then Jo'burg probably has the sheer ambition and energy to make good on it. □

WEBSITE EXCLUSIVE Photographer Tomasz Tomaszewski calls Johannesburg "the most dangerous, difficult shoot of a lifetime." Share Tomasz's experiences and see more of his pictures at **nationalgeographic.com/magazine/0404**.



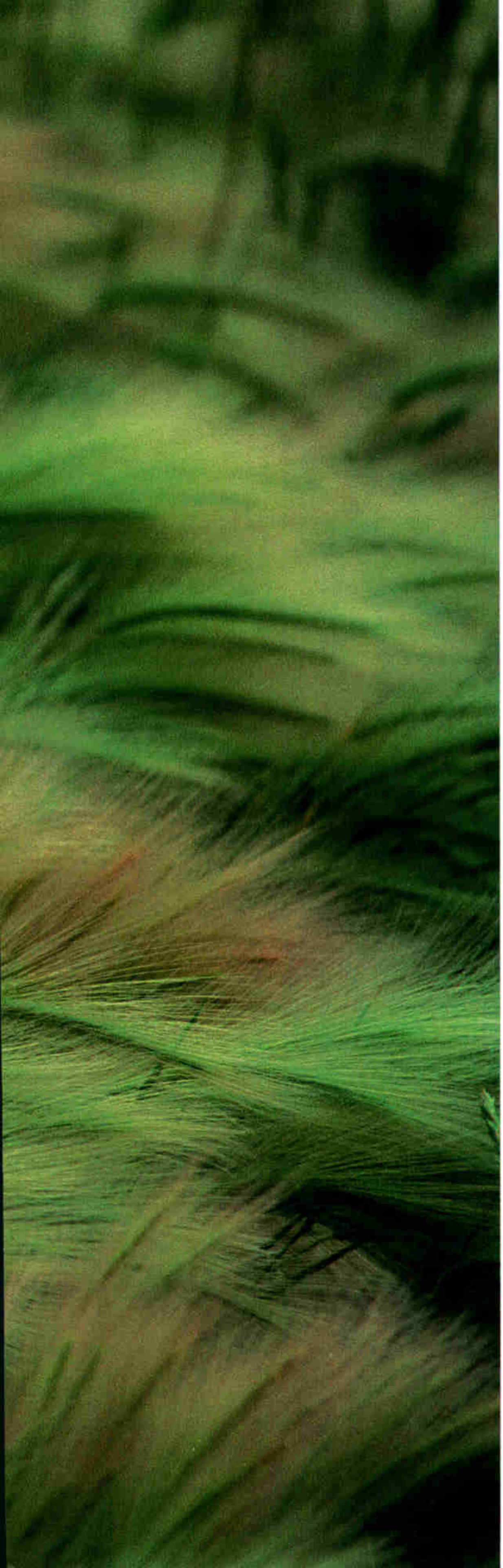
AMERICAN LANDSCAPES

reefs in a prairie sea

For half a million years, water and wind have sculpted fantastic rock art in southwestern South Dakota, mesmerizing visitors to Badlands National Park. Life is scarce in these stark buttes. But a surrounding ocean of grasslands includes healthy numbers of buffalo, coyotes, pronghorn, and birds of prey. Here the prairie endures.







BY JOHN L. ELIOT
NATIONAL GEOGRAPHIC SENIOR WRITER

PHOTOGRAPHS BY
ANNIE GRIFFITHS BELT

A "Homecooking" sign, perched on the side of a gravel road in southwestern South Dakota, stops me. It leads to a brown sheet-metal building, the Cuny Table Cafe—two booths and one round table, first come, first served. Nellie Cuny and her sister do most of the cooking, which runs to T-bones and Indian tacos. Nellie's 61-year-old son, Marvin, does most of the talking. He offers me a ride around their sizable spread.

With Marvin's pickup locked in four-wheel-drive, we lurch for hours over Cuny Table, the plateau where his family has been raising horses and cattle for more than a hundred years. The family has stayed because this is the fat of the land: buffalo grass, wheatgrass, and grama grass, the full bushel basket of the mixed-grass prairie.

Marvin drives slowly through rippling pasture as several Cuny mares and foals sidle up. We stop. Knowing Marvin's truck may yield treats of grain cubes, some lay their muzzles on the hood.

The land benefits more than livestock. We see long-billed curlews—huge sandpipers—twittering overhead. Mule deer lift their heads, all ears. Half a dozen pronghorn, speed kings of North America, watch us nonchalantly.

WAVES OF GRASS
A breeze ruffles wisps of foxtail barley and western wheatgrass, both indigenous. About 55 species of grass thrive in this mixed-grass prairie, including little bluestem, blue grama, and buffalo grass.



CUTE MENACE? *Prairie dogs are protected in the park, but neighboring ranchers kill them for digging up pastures. The park and Buffalo Gap National Grassland form 850,000 acres of a larger ecosystem (facing page).*

Then two of them bolt as if a gun had fired. Legs hidden in the grass, their tan-and-white bodies blur.

To the north, along the rim of Cuny Table, the horizon suddenly changes. The prairie gives way to a stark and eerie landscape, an area so desolate that the U.S. Air Force and later the National Guard used it for bombing and artillery practice from 1942 until 1970. "We lived next to the range," Marvin says. "Planes dropped targets with parachutes, and we'd watch where they came down. Then we'd go get the parachutes and make silk curtains and tablecloths out of 'em."

THE GREAT-GRANDFATHERS OF THE OGLALA SIOUX called the land north of Cuny Table *mako sica*, "land bad." They had good reason. Eons of water and wind have carved the region into a wild maze of cliffs, canyons, spires, pinnacles, castles, balancing rocks, tables, gullies. Almost nothing lives in the hot, naked buttes except turkey vultures that soar and scan for a jackrabbit's carcass. French-Canadian fur trappers reviled the landscape as *les mauvaises terres à traverser,* the bad lands to cross.

Yet there is a richness to this desolation. These same haunting buttes draw 900,000 people a year to Badlands National Park, the heart of the landscape. Most come to drive along the Wall, a long, narrow rampart of colorfully banded cliffs and buttes that stretches some 60 miles from west to east. Surrounding the Wall and associated battlements, and woven through gaps among them, spreads 600,000 acres of prairie—most of it tended by the U.S. Forest Service as Buffalo Gap National Grassland. Together the two areas create a vast ecosystem of nearly 850,000 acres, a land of silence where thunderheads roam far horizons.

A middle ground between the sheer buttes and the flat grassland is a treasure in itself. A few miles west of the Wall, the buttes give way to low emerald hills threaded by cedars and cottonwoods—the park's Badlands Wilderness Area. Here Sage Creek and its branches wind for miles through an old floodplain. It's irresistible to a hiker seeking solitude: The only trails are maintained by some 800 buffalo, reintroduced beginning in 1963. In the ecosystem's grasslands, endangered

black-footed ferrets also have been reintroduced, as have a few bighorn sheep, which are rarely seen.

I pick a buffalo trail and follow it south. Small groups of bison graze on tiny meadows below the hills. A coyote, pale as a ghost, lopes down a slope. The breeze carries the songs of western meadowlarks, rock wrens, and western kingbirds. Three old bulls, grazing near a primitive campground, have lost half their winter coats. Their front ends flap in the breeze like moth-eaten blankets; their fully molted rear ends stand naked as gray rhino hide.

Eons of water and wind have carved this country into a wild maze—geology on an erosion spree.

EACH SUMMER AS MANY AS 10,000 VISITORS to Badlands National Park discover the real reason the park was created. Off the park's paved Loop Road, under a large shelter, they can watch researchers tease 33-million-year-old bones from the ground. These are White River fossils, fossils from the same formations—found throughout the park—that since 1846 have yielded thousands of specimens to famous bone hunters like Joseph Leidy, Othniel Marsh, and Ferdinand Vandiveer Hayden. Museums worldwide—including Yale's Peabody Museum, the American Museum of Natural History, and the Smithsonian—display White River fossils as classic examples of mammalian evolution.

After 11 seasons this site, called the Big Pig Dig, has given up more than 8,000 bones from the Oligocene, *(Continued on page 90)*





ROLLING THUNDER



A storm sweeps over buttes near Pinnacles Overlook, part of the Badlands' signature formation known as the Wall. Stretching for miles west to east, this daunting geologic feature was carved over the past 500,000 years by three river systems that eroded the edge of a high plateau of claystone.



CRUMBLING EARTH



Isolated buttes and timeworn rock fragments lie scattered east of Cedar Pass. In their own tongues, French-Canadian fur trappers and Sioux disparaged such country as "bad lands." The term now loosely defines any hilly terrain on Earth that is severely eroded into a forbidding landscape.

"Right out of the ground, a fossil might sell for $300. But after it's prepared and polished, it might bring $3,000."

the golden age of mammals, 34 to 25 million years ago. (The site takes its name from the first fossil found here—originally thought to be from a fearsome piglike animal.) The Badlands hold no bones of dinosaurs, since the area was a vast inland sea during their reign. By the Oligocene, the dinosaurs were long gone, the inland sea had drained, and early mammals were colonizing the flourishing forests and savannas. The Big Pig Dig, a water hole that trapped animals in mud as it dried out, reveals a valuable cross section of evolution, mostly experiments that didn't make it: hornless rhinoceroses, tiny deer, horse prototypes, leopard-size cats.

The two visitors who reported the first Big Pig Dig bones, in 1993, left them undisturbed—a happy but atypical experience to the park staff. In fact, the White River Badlands were proclaimed a national monument in 1939 and elevated to a national park in 1978, mainly to protect the fossil beds from nonscientific collectors. Researchers with permits may collect here, but no one else.

About 35 times a year park rangers issue a warning or a small fine to visitors who pick up a tooth and don't know better. But one case involving fossil theft and attempted sale drew a $2,500 penalty; the law provides for a maximum of ten years in jail and a $250,000 fine. "Our big concern is the professional fossil hunter," says Scott López, the park's chief ranger and law enforcement officer. "Right out of the ground, a fossil might sell for $300. But after it's prepared and polished, it might bring $3,000."

A few years ago a young ranger came across a partially buried fossil skeleton. It was a titanothere, a mammal the size of a small elephant, with hornlike projections on its snout. Illegal hunters already had removed some bones; the rest have now been preserved on site. The first fossil ever discovered in these Badlands was a titanothere jaw fragment reported in 1846.

But the recent titanothere has become a bone of contention. It was found near Stronghold Table, in the park's South Unit, 133,000 acres of tribal land owned by the Oglala Sioux as part of the Pine Ridge Indian Reservation. Managed in trust by the Department of the Interior, the South Unit is part of the national park. Though the Sioux do not live there, Stronghold Table is sacred ground to the Sioux, site of one of their last Ghost Dances, in 1890. Later that year a band of Sioux, despite having surrendered, was massacred by U.S. troops 30 miles south along a creek with an infamous name: Wounded Knee. The Sioux still hold religious ceremonies on Stronghold Table, and they have strong opinions about what they will and will not permit on their land.

In 2002, invoking cultural preservation, Sioux protesters halted the Park Service's efforts to excavate the rest of the bone bed. "It's a stalemate," López says. "We may have to bring in an outside mediator."

WHEN THE BONES OF THE BADLANDS turn up in the wrong hands, "Rachel Benton is the first person we call," says López. "She has to tell us what we're looking at." Benton, the park paleontologist, is a busy person. "Besides outright theft, now we have to worry about



LIVING FOSSIL
A western painted turtle crawls over a parched land, which bears the bones of its ancestors. The park is known for its fossils, especially those of early mammals often more than 30 million years old.

geo-caching," says López. In this latest twist to a treasure hunt, people hide a container and perhaps a trinket, take the GPS coordinates, and put the coordinates on the Internet. Other people go to the location and try to find the cache.

Although a treasure hunt may seem a nuisance at worst, and can have the positive effect of getting people out in nature, López warns of an escalation: Some geo-cachers are finding fossils in park rocks and putting those coordinates on the Web. Anyone can then come to look—or to take.

"To us, a shovel is a shovel," says Benton. "Digging up anything here is illegal." Her mental radar always on, Benton notices every vehicle parked on the roadside and scans for people carrying trowels and large packs.

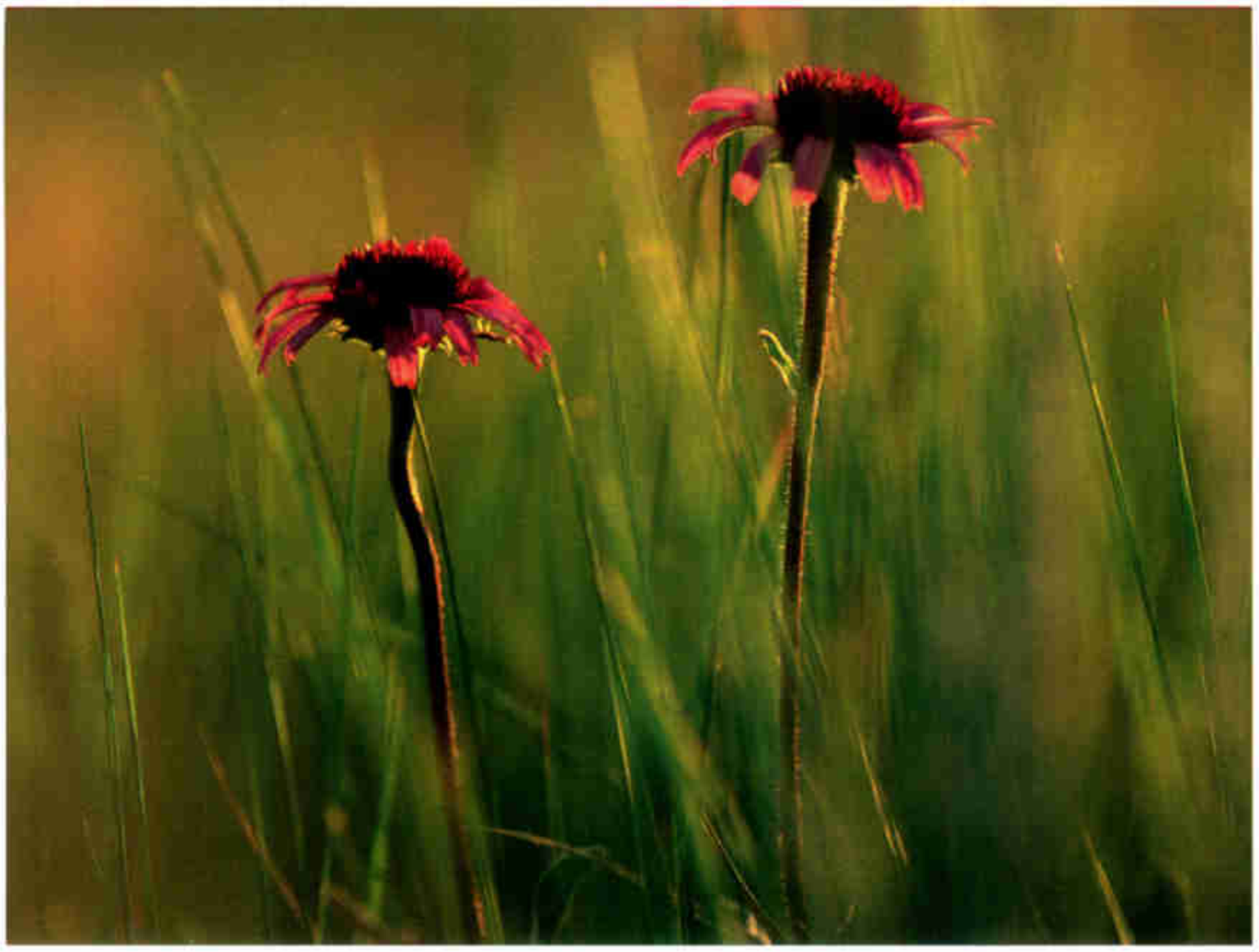
While something can be done about fossil theft, little can be done about the other, natural, processes that damage fossils—wind and water erosion. Pointing to the Wall near Cedar Pass, Benton explains: The Badlands formation consists mostly of claystone, hundreds of feet thick, that washed down from the Black Hills to the west between 37 and 25 million years ago. Yet the sculpting of the Badlands began a mere 500,000 years ago, an eyeblink of geologic time.

"That's when the Cheyenne, the White, and the Bad River systems began to flow over all that clay sediment and carve the Wall," Benton says. "And at the present rate of erosion, this will all be gone in another half million years." Long before that, of course, countless fossils will be washed away. Water and wind continue to carve the Badlands, claiming up to an inch or more in some places each year.

"Probably an oreodont," Benton says as we walk along a butte and she spots a fist-size skull protruding from the bank. "We find them throughout the park. Sheeplike mammals that lived in herds about 30 million years ago." The fossil lies intact in the soil, but Benton knows other eyes are searching for such a find. Back in the car, we round a bend.

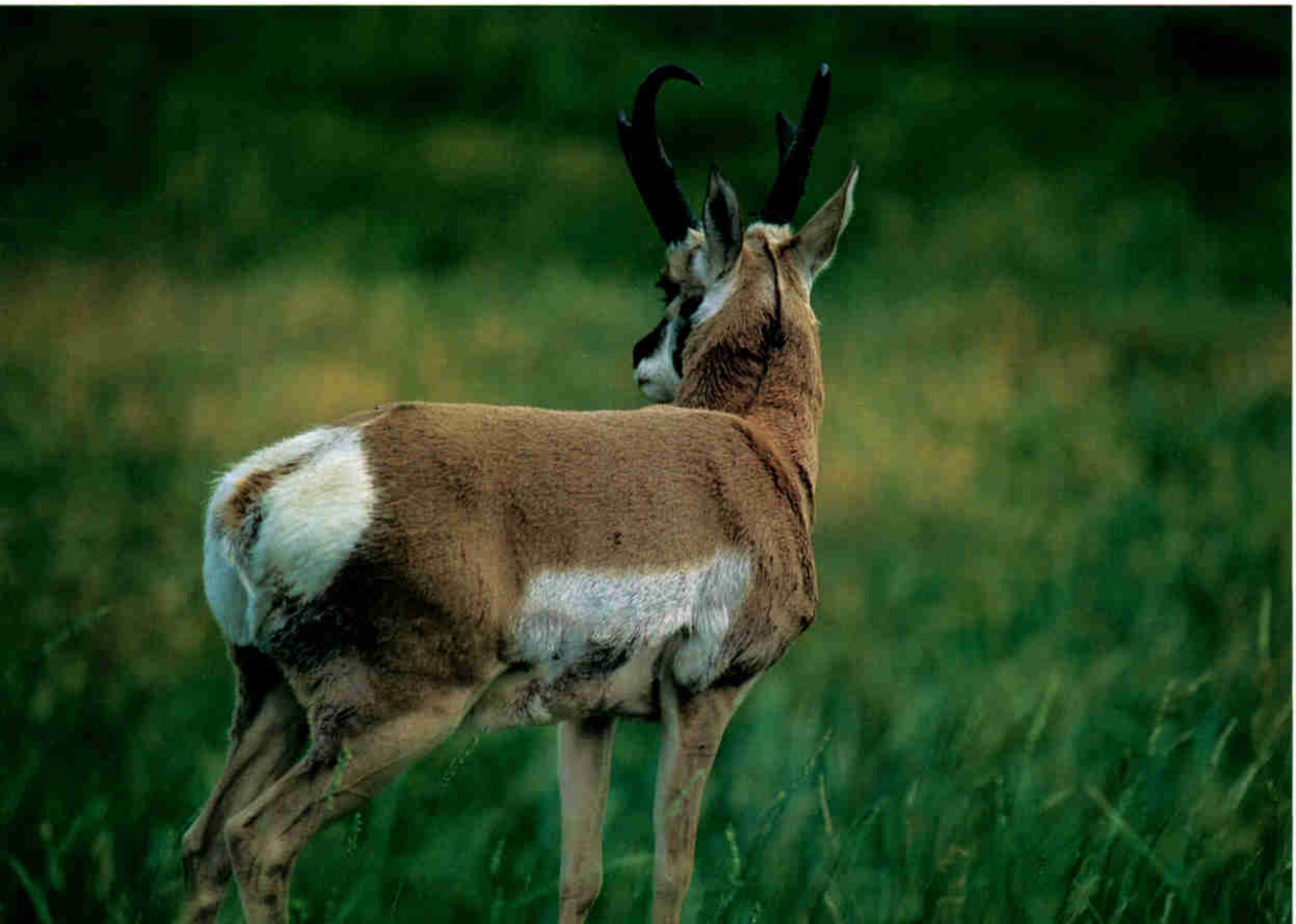
"Stop," she says. "I want to check out that van."

GET LOST IN THE BADLANDS Find out how to get there, what to see and do, and where to stay in our Online Extra at **nationalgeographic.com/magazine/0404**.



THE LUSH LIFE

Rising like artful hors d'oeuvres, purple coneflowers (above) are tempting for grazers. Needle and thread (below right) earned its name from its sharp florets. South Dakota's prairie larder has thinned in the past 30 years—about a million acres of grassland have been lost to agriculture. But two million acres lie preserved in areas like Buffalo Gap National Grassland.





Hooves and what falls behind them help the prairie regenerate by disturbing soil and distributing seeds. Nearly extinct a century ago, bison have been steadily reintroduced and now number about 2,500 in South Dakota's national and state parks. Bison and pronghorn (below left) forage on tree seedlings, a service that keeps forests from overtaking grasslands.

PRAIRIE PARTNERS





ELEMENTS OF DESIGN

Light and shadow play over Sage Creek Basin. Nature's architecture impressed one of its best students, Frank Lloyd Wright. He traveled this region in 1935 and rhapsodized over "delicate parallels of rose and cream." "I was totally unprepared for that revelation called the Dakota Bad Lands."



COLLISION OF EARTH AND SKY

The Sioux called them Thunder Beings, storms that regenerate the land. Last June this Badlands front spawned tornadoes in eastern South Dakota. Yet lightning sets fires that can kill alien species and help native grasses reseed. Today controlled burns renew prairie that hasn't met the plow. □

A QUESTION OF BALANCE

HOW TIGERS, GOLD MINERS, AND GUN-TOTING REVOLUTIONARIES ARE COMPETING TO SURVIVE IN MYANMAR'S "VALLEY OF DEATH"

A peddler of palm fronds navigates the Tarung River in the once isolated Hukawng Valley.



A trophy board of monkey and deer skulls adorns the home of a Lisu hunter. One of three major ethnic groups in Hukawng Valley, the Lisu now kill animals for profit as well as sustenance. Hunting wildlife to feed the rush of gold miners is taking its toll on tiger density.



BY ALAN RABINOWITZ

PHOTOGRAPHS BY STEVE WINTER

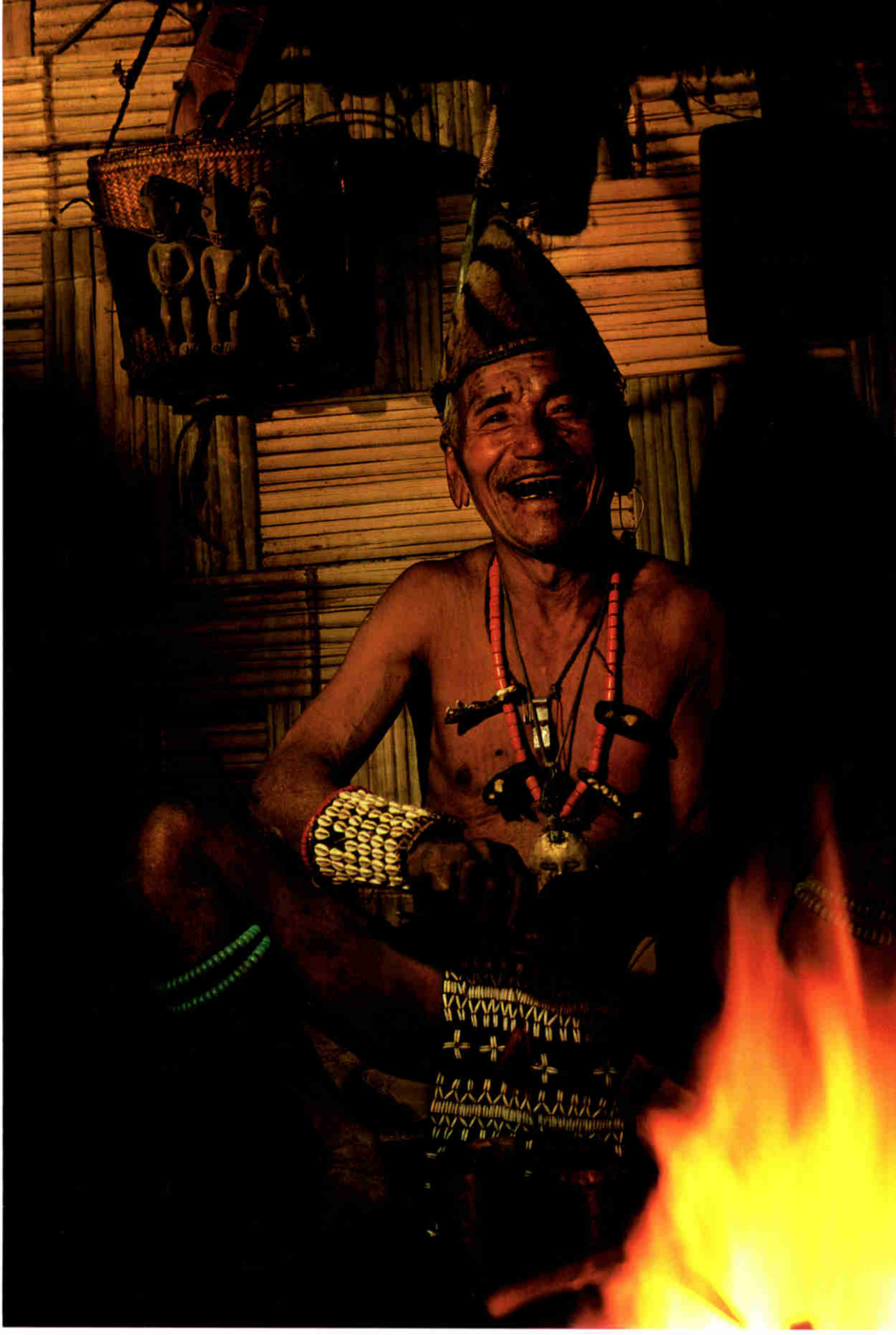
Glamorous sounds assault me through the mosquito netting. It takes a few seconds to get my bearings. On my last trip to this same place I was awakened by the early morning calls of gibbons, the distant trumpeting of elephants, and the raucous sound of hornbills. Now, as my head clears, I recognize the harsh coughing of truck engines and the repetitive thump-thumping of hydraulic pump motors. Through the open shutters of my hut I can see the forest canopy in the distance. This is still the picturesque little hamlet of Shingbwiyang, once home to only a few hundred residents deep inside the Hukawng Valley of northern Myanmar, formerly known as Burma. But a major gold rush, started during the year I've been away, has brought thousands of people swarming to this remote site. This is not what I was expecting.

As director of science and exploration for the Wildlife Conservation Society (WCS), my goal is to explore and try to conserve the world's last wild places. That's why I've come back to the Hukawng Valley. After an initial survey of the area showed it to be rich in tigers and other wildlife, the Myanmar Forest Department created a large wildlife sanctuary in an uninhabited section of the valley in April 2001. A few months later the government upped the ante. I still remember my shock when colleague Saw Tun Khaing called me in New York with the news.

"They want to triple the size of the sanctuary! They're proposing the whole valley as the country's first tiger reserve," Khaing told me over

LURE OF THE VALLEY

Hoping to prosper from hunting or gold mining, migrants enter Hukawng Valley from the north (top). In Naryang, a remote Naga village, a shaman (right) maintains the old ways despite the influx of outsiders.





UNCERTAIN OUTLOOK

This Asiatic leopard cub was orphaned when hunters killed its mother to sell her body parts for use in traditional medicine. Hunting for profit would be outlawed if the entire Hukawng Valley is turned into a wildlife preserve as planned.

the phone. "And they want our help to make it happen." Since I'd first begun working with the Myanmar government in 1993, no one had ever proposed anything of this magnitude. At nearly 8,000 square miles—close to the size of Vermont—Hukawng Valley would be the largest tiger reserve in the world.

As I walk around the village of Shingbwiyang on this return trip, the task of creating a reserve here seems daunting. Khaing, a former official with the Myanmar Forest Department and now the coordinator for WCS's Myanmar program, accompanies me along the edge of a clearing for half a mile. We enter a ragtag assortment of tarps and buildings that cater to the gold miners. On a dirt field where I once measured tracks of tigers and elephants, vendors in stalls are now selling pharmaceuticals, hardware, and clothing. Discordant singing blares from the speakers of a karaoke bar as we pass restaurants, coffee shops, and a barbershop offering both massage and a pool table. Everywhere are the scales used to weigh the gold brought in for barter.

When the WCS had done its initial survey in 2000, much of this valley was sparsely populated or uninhabited. Yes, people came to the forests from nearby villages during the dry season to do small-scale gold panning and to harvest bamboo, rattan, and aloes wood. But few settled for long.

Then, just as the Forest Department was setting aside the sanctuary, another branch of the government was rebuilding the washed-out bridges that had kept the valley isolated for decades. The result? Tens of thousands of people have poured into the valley in search of gold. Many who initially came for the riches have cleared land and plan to stay. The reopened section of road leading from Shingbwiyang to the town of Tanai—a 44-mile journey that once took me five days of walking—is now crowded with a constant flow of trucks stacked high with food supplies, gasoline drums, and PVC pipes. Rattan harvesting has accelerated: The wild supply, by one estimate, is less than two years from depletion. Guns have replaced crossbows as the weapon of choice, and dynamite fishing is depleting the once rich waterways.

At a nearby gold mine I get to see what all the excitement is about. "Watch your step," says Myin Yang as I edge up to a 50-foot-deep pit in the ground. "Don't fall in." She is the wife of a local Forest Department official who has leased this land from the government. "See what we got yesterday?" She holds out her hand, proudly displaying a pea-size ball of glistening gold. It is worth $12.50; her final profit will be a fraction of that. Still, since many Burmese workers make about a dollar a day, this is clearly something to be pleased about.

My eyes move from the gold back down into the pit. Two mud-covered workers strain to steady a high-powered water hose eating away at the earth, making the crater larger and deeper as I watch. Khaing taps me on the shoulder and points. A deforested, sterile landscape, pockmarked with pits similar to the one in front of us, stretches for miles into the distance. Streams flowing through the area are filled with brown, muddy water, poisoned with the cyanide and mercury used to extract gold from the sludge.

Khaing and I find *(Continued on page 109)*

TAKING A HEAD COUNT

The first step to saving Myanmar's tigers is figuring out how many are left to be saved. "But until recently we had no systematic way of measuring tiger density," says Alan Rabinowitz, director of the Wildlife Conservation Society's science and exploration program, who is working with the Myanmar Forest Department to triple the size of the 2,500-square-mile Hukawng Valley Wildlife Sanctuary. The tigers' size and elusive behavior made capturing and counting them nearly impossible. In 2003, taking a cue from photographers, Rabinowitz and his Myanmar colleagues used camera traps—cameras that take photos when a heat sensor trips the shutter as an animal passes—to get the first census of the tiger population in the valley. While overhunting had clearly lowered the area's number of tigers, no one knew by how much.

As part of the census, team members Khin Htay (top, at left) and Nilar Pwint, at right, took posters illustrated with local species to every village in the valley, asking which animals are seen in the wild, which are hunted for food, and which are sold. Another team mounted camera traps at locations in the sanctuary where tigers had been seen or tracks were visible (center).

Later, in the capital city of Yangon, team members studied the photos to ensure an accurate count (bottom). The verdict? Probably fewer than a hundred tigers remain in the valley. "It's lower than I'd hoped, but that number will come up if the tigers are protected," says Rabinowitz. "Our aim isn't to stop people from hunting for food, but to stop them from selling animals for profit."

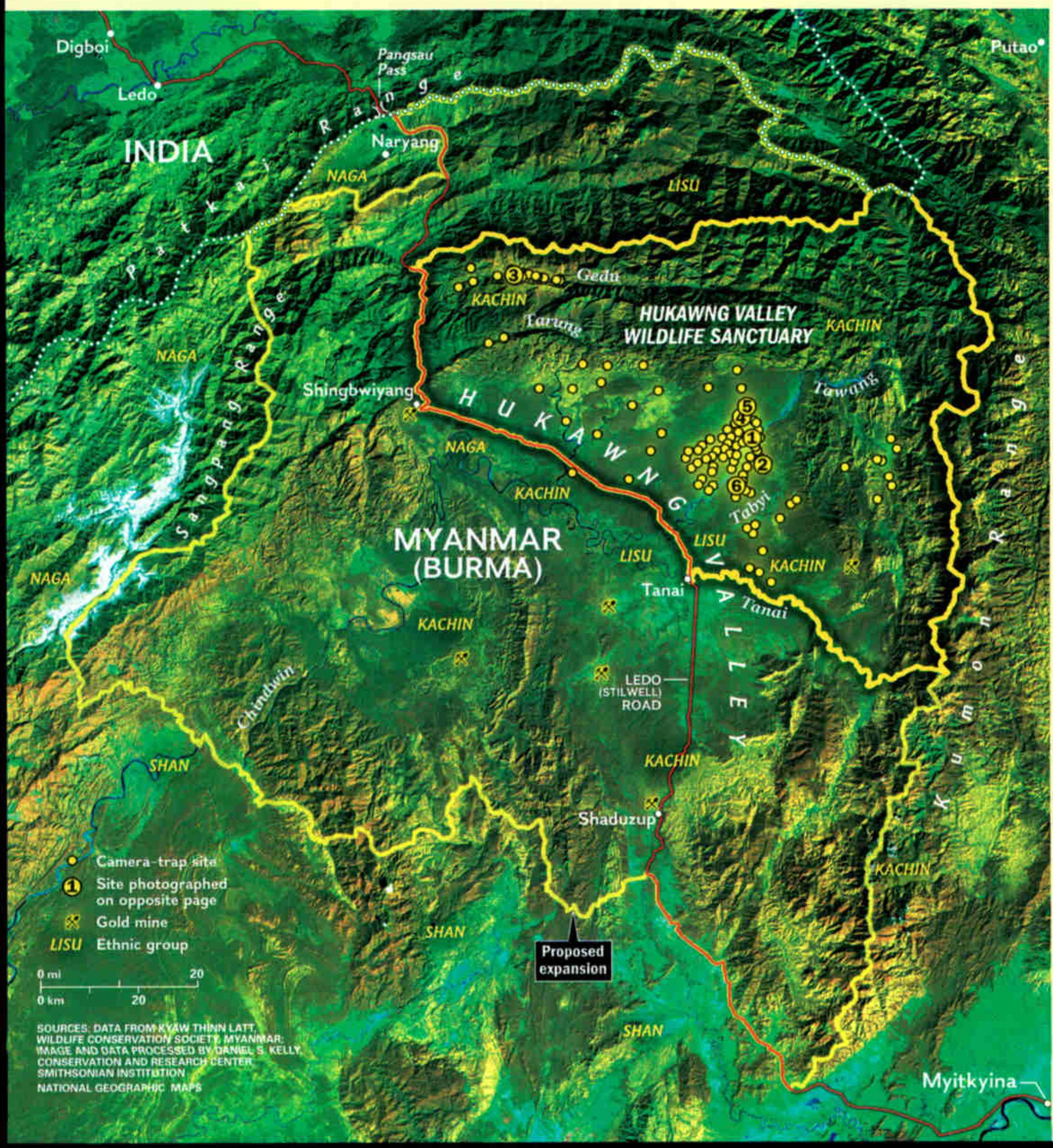
—Cliff Tarpy



WHO GOES THERE?

In the sanctuary, where hunting is banned, camera traps at various locations (map below) captured a menagerie of animals. Shown on the facing page with numbers keyed to their location, they include a tiger (1), macaque (2), golden cat (3), elephant (4), Asiatic black bear (5), and clouded leopard (6). Plans are now afoot to create the world's largest tiger refuge by adding 5,500 square miles where tiger hunting would be prohibited, but some other animals could be hunted for food in "exclusion zones."





SOURCES: DATA FROM KYAW THINN LATT, WILDLIFE CONSERVATION SOCIETY, MYANMAR; IMAGE AND DATA PROCESSED BY DANIEL S. KELLY, CONSERVATION AND RESEARCH CENTER, SMITHSONIAN INSTITUTION
NATIONAL GEOGRAPHIC MAPS



1



2



3



4



5



6

WILDLIFE CONSERVATION SOCIETY (ALL)



a nearby food stall and order Cokes. A set of animal legs hangs from a rafter by the kitchen. They are from a wild boar, a favored prey of tigers. Khaing tells me the sign out front advertises fresh sambar deer and wild boar meat at prices cheaper than those for domestic pig and chicken. He looks worried.

"Do you still think we can pull this tiger reserve off?" he asks suddenly.

I'm wondering the same thing.

I'd first heard of the Hukawng Valley in 1996, while working in northern Myanmar to help set up another wildlife reserve. At the time, Myanmar had been closed to the Western world for more than three decades. The ruling military junta was being pilloried in the world press for its human rights record, but my mission wasn't about politics. I desperately wanted to preserve the wildlife in this remote corner of the world. With its vast forests and relatively low population density, Myanmar was thought to possess the second largest number of tigers in Asia, after India. But poaching was taking its toll. According to TRAFFIC, a network that monitors the international wildlife trade, at least 50 to 100 tigers were killed every year in Myanmar during the 1980s for use in traditional Asian medicines. If these numbers were accurate, the country's tiger population was in trouble.

At village markets in northern Myanmar, I'd see the body parts of tigers, gaur, and clouded leopards being sold for traditional medicines. When I'd ask where the animals had come from, the reply was always the same: Hukawng Valley. Hunters said it was filled with wildlife, but that the jungle was unforgiving. My maps showed only an extensive slab of green between the Sangpang and Kumon mountains, seemingly empty of major roads or human settlements. The original name of the valley, *ju-kawng*, means "cremation grounds" in the Jinghpaw dialect of the Kachin people, who have long dominated this northern region. But during World War II the British gave it another name. The Japanese controlled most of Burma, and a footpath through the valley became an escape route for refugees and Allied soldiers fleeing to India. So many people died en route that Hukawng

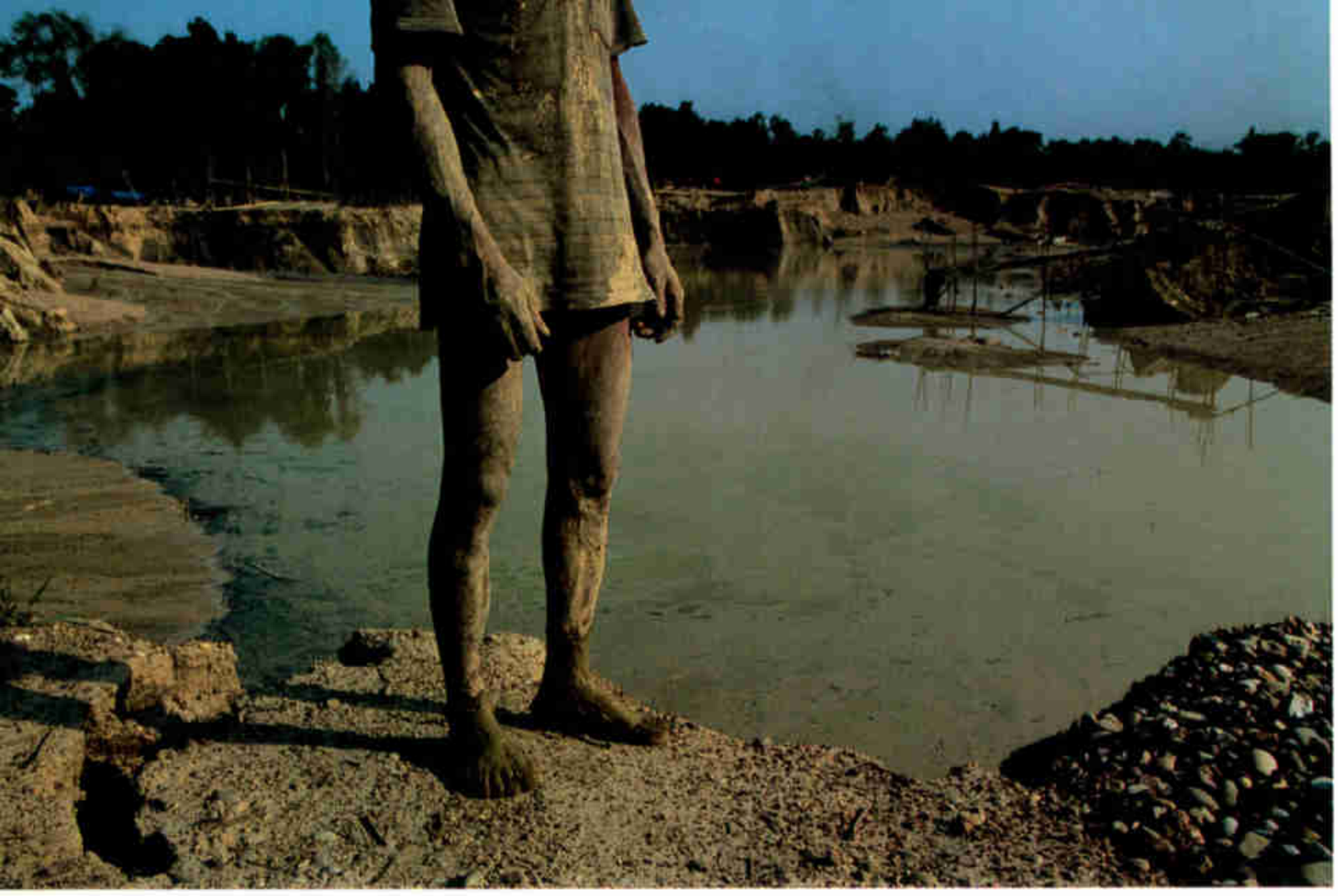
VIOLENT HARVESTS

For eight dollars, hunters killed a bear to sell its paws, a delicacy in some Asian countries (opposite). A vendor in Myitkyina displays lizards, insects, and animal parts used to make medicine.



Amid lush forest, a hunter waits to cross the Tarung River as elephants and their mahouts head downstream toward gold-mining country. Hukawng's waterways once slowed pedestrian and vehicle transport but are now spanned by bridges, hastening human settlement.





MUCKING UP THE PLACE

To extract gold, miners use water hoses to create huge pits that feed runoff ponds (left) laced with cyanide and mercury. In bustling Shingbwiyang (opposite), scales in a roadside shop are used in bartering.

became known as the "Valley of Death." Between 1942 and 1944 American Gen. Joseph "Vinegar Joe" Stilwell cleared a land route of close to 500 miles passing through the Hukawng Valley. Described as the "man a mile" road because so many died of malaria, typhus, and sniper fire, the Stilwell Road was finished only months before the war ended. (See "Burma Road," November 2003.)

Soon afterward the thick jungle reverted back into the hands of the Kachin people in the lowlands and the Naga, their neighbors in the mountains. The road became impassable as floods washed away bridges along the Chindwin River. In an effort to keep out government forces, the Kachin Independence Army (KIA) destroyed the few bridges that remained. The valley has been the KIA's base of operations since 1961, when the Kachin began their fight for autonomy from the central government.

The mosquitoes and washed-out bridges kept most people away and made my first trip into the valley, in 1999, grueling. It took two weeks to cover 150 miles, much of it on foot or by boat. The weather alternated between battering rains and scorching sun. But the rumors of plentiful wildlife appeared to be true: Our early surveys confirmed the presence of bear, clouded leopard, sambar deer, barking deer, wild boar, dhole, and other species that had disappeared or were declining elsewhere in the country. Most exciting was evidence that the Hukawng Valley might be home to a significant portion of Myanmar's remaining population of tigers.

The government's decision to set aside the valley as a reserve was an acknowledgment that, if things didn't change, tigers might not survive in their country. It soon became clear, however, that declaring the entire valley an inviolate wildlife sanctuary—without taking into account the needs of the people living there—wouldn't work. While protected areas are necessary for animals to live and reproduce in peace, the long-term survival of large, wide-ranging species such as tigers and elephants depends on conservation schemes that go beyond strict protected areas. Animals shouldn't be killed simply because they cross invisible boundaries. At the same time, local people need a way to make a living. Banning all hunting, fishing, and other uses of forest and wildlife in the entire valley wasn't realistic. Enforcement would be virtually impossible.

And so I am working with the Myanmar government to designate the most populated locations in the valley as "exclusion zones" or "multi-use areas," where activities such as fishing, hunting for personal consumption, and rattan collecting will be allowed, though regulated. But in order to save the tigers, clear-cutting, slash-and-burn agriculture, wildlife trade, and large-scale gold mining will still have to be prohibited everywhere in the valley. Too many conservation plans fail because conservationists assume that animals will be protected once local people are lifted out of poverty. My model is different. Properly done, I believe there can be an enforceable, dynamic balance between people and wildlife.

Now that I see how much has changed in the valley, though, I worry I may be too late. Maybe Hukawng has become an "empty forest"—one that looks like a perfect habitat for tigers yet in

fact is devoid of such life. With thousands of people living so close to the forest, it's possible that too many tigers have already been lost. Before moving forward with the reserve, I need proof there are enough tigers to warrant the effort. That proof, I hope, is waiting for me in the nearby town of Tanai.

When I arrive in Tanai, the WCS field team is waiting. They greet me with smiles, then hand over a thick envelope of photographic contact sheets. They have been in Hukawng Valley for three months conducting a systematic survey inside the wildlife sanctuary. Their primary tool: an automatic camera in waterproof housing triggered by an infrared beam that detects body heat. These "camera traps" photograph anything passing in front of them, signaling the presence of species that don't always leave obvious signs. In the case of tigers, they can even identify individual animals, since no two have the same stripe patterns. The survey will provide the first real estimate of tiger density in the valley. I scan the sheets carefully.

"What are the numbers?" I ask, referring to the analysis that was done based on the photos.

"Two to three tigers per hundred square miles," the team leader says, "maybe eighty to a hundred in the whole valley."

I'm relieved. The tiger numbers are sufficient, though far below what they could be for a lowland forest like this, where I'd expect perhaps as many as ten tigers per hundred square miles. Still, there is a population here that can thrive—and multiply if protected. Along with the tigers, there are photos of 32 other species of mammals and birds, indicating an intact natural system. But the camera traps have also captured images of hunters walking the same trails as the wildlife, some with crossbows, many with guns.

A man named Ah Puh squats beside me and points at the pictures. A member of the Lisu tribe from the north, he is one of the most skilled hunters in the valley. He works for the WCS now, showing us the best places to find tigers. He knows the people in the pictures. Most of the hunters, he says, are Lisu, coming from near the city of Putao 80 miles to the north. But the men in green uniforms are with the Kachin Independence Army. For some reason I had assumed that, by their presence, the KIA were doing more to protect the wildlife in the forest than to threaten it. But these photos indicate otherwise.

Using Khaing as an interpreter, I ask Ah Puh if any of the hunters in the photos are Naga,

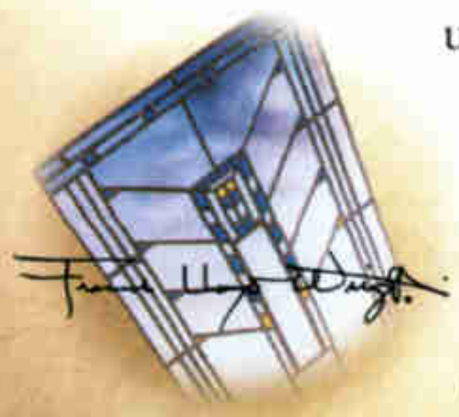




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canopy. A great hornbill flies overhead as we round a bend in the river.

Soldiers in uniform are waiting for us on the bank. Most of them look to be in their teens. They usher us into a village that serves as their military compound and invite us to sit at an outdoor table. The three senior KIA officials opposite me are in their 40s or early 50s, their faces hardened by a life of conflict. Khaing translates as I briefly explain the history of WCS's work in the Hukawng Valley and ask if they're willing to help us.

"This is our land," the KIA commander replies. "The Kachin people have always been told not to kill certain animals like tigers, elephants, and monkeys. We know we need these resources for the future."

"I know you teach respect for certain animals," I say. "But maybe you don't realize what's happening when you're not there to see it." I hand over some of the camera-trap photos showing KIA soldiers hunting and watch their expressions as the pictures are passed around. These men are not surprised. They know exactly what is happening in their forest.

"Some of your soldiers use their weapons to kill anything they find," I continue. "And the animals you say shouldn't be killed are hanging in the markets of Tanai and in the gold camps. Even if the Kachin don't kill tigers, they kill all the tiger's food. Soon the tigers and everything else will be gone."

One of the officers scowls, then says something to another officer. No one is smiling.

"We'll help if we can," says the commander. "But our people have to eat. And we need money for the cause. Sometimes this creates conflict. Conflict is part of life."

Frustrated, I start to outline some of the plans



LIQUID HIGHWAY

Once a primary means of travel within the valley, the Tanai River remains a key way for residents to transport rattan and bamboo. Newfound income from mining has enabled more locals to afford workboats, speeding up the harvest of Hukawng's valuable—and finite—natural riches.

WCS wants to put into place over the next five years—programs to raise livestock, cultivate non-timber products such as rattan and bamboo, develop ecotourism, and introduce environmental education in schools. If people raise domestic pigs and chicken for food instead of hunting sambar deer and wild boar, the tigers could once again become plentiful. I tell the men I'd like to hold a meeting that brings together representatives of the different ethnic groups in the Hukawng Valley. Whatever we do next will be based on what the people living here want.

The men seem to relax, and say they'll allow their soldiers to attend a meeting. Lisu and Naga village leaders have also agreed to participate. It's a crucial first step, just as it was for Ah Puh to recognize that maybe it's time for a change.

For the rest of the day I roam through the military compound and the adjacent village where the soldiers' families live, accompanied by a young captain in his 20s. The captain, like many of the other young soldiers, says he was recruited two years earlier. Refusal was not an option. He says he's not unhappy here, but he hopes for a different life for his children.

That evening uniformed teens serenade us with songs of love, family, and revolution. They sing of a troubled past and an uncertain future. Yet I hear no sadness in their voices. They seem to look ahead with unbridled optimism.

Suddenly I feel optimistic too, for the first time on the trip. This can really work, I tell myself. I didn't come here to help the people. I came to save tigers. But now the lines are blurring, and I'm glad. Hukawng Valley has been a place of struggle and death for more than a century. Maybe now it can be a place of life, of coexistence between people and nature. I'm not fooled into thinking there aren't immense challenges ahead. I know there will be problems and setbacks. But in the end I'm convinced the Hukawng Valley tiger reserve can succeed.

The next morning, Khaing and I carry our belongings to the river where a boat will take us back to Tanai. Although the real work still lies ahead, the KIA has agreed to the meeting and, for now, that is progress. While we wait, a little boy walks toward me, dressed in full KIA uniform.

"Are you a soldier already?" I ask the boy. He looks about seven, just a few years older than my own son back home.

"I'm too young. But I'll be a soldier soon," he responds officiously, both scared and impressed to be talking to a foreigner.

"Do you like to live out here in the forest?" I ask. "Aren't you afraid of the tigers?"

"I like the animals. And I'm not afraid of anything in the forest. My father says the forest is our home."

I tousle his hair and smile. "The forest is home for the animals too," I say. Then I turn to walk toward the boat that's arrived.

"We can share the forest," he says to my back. "There's enough." □

WEBSITE EXCLUSIVE Get an update on Alan Rabinowitz's progress in creating the world's largest tiger reserve, and learn about Steve Winter's slippery encounters with quicksand and leeches at **nationalgeographic.com/magazine/0404**.

WISCASSET, MAINE

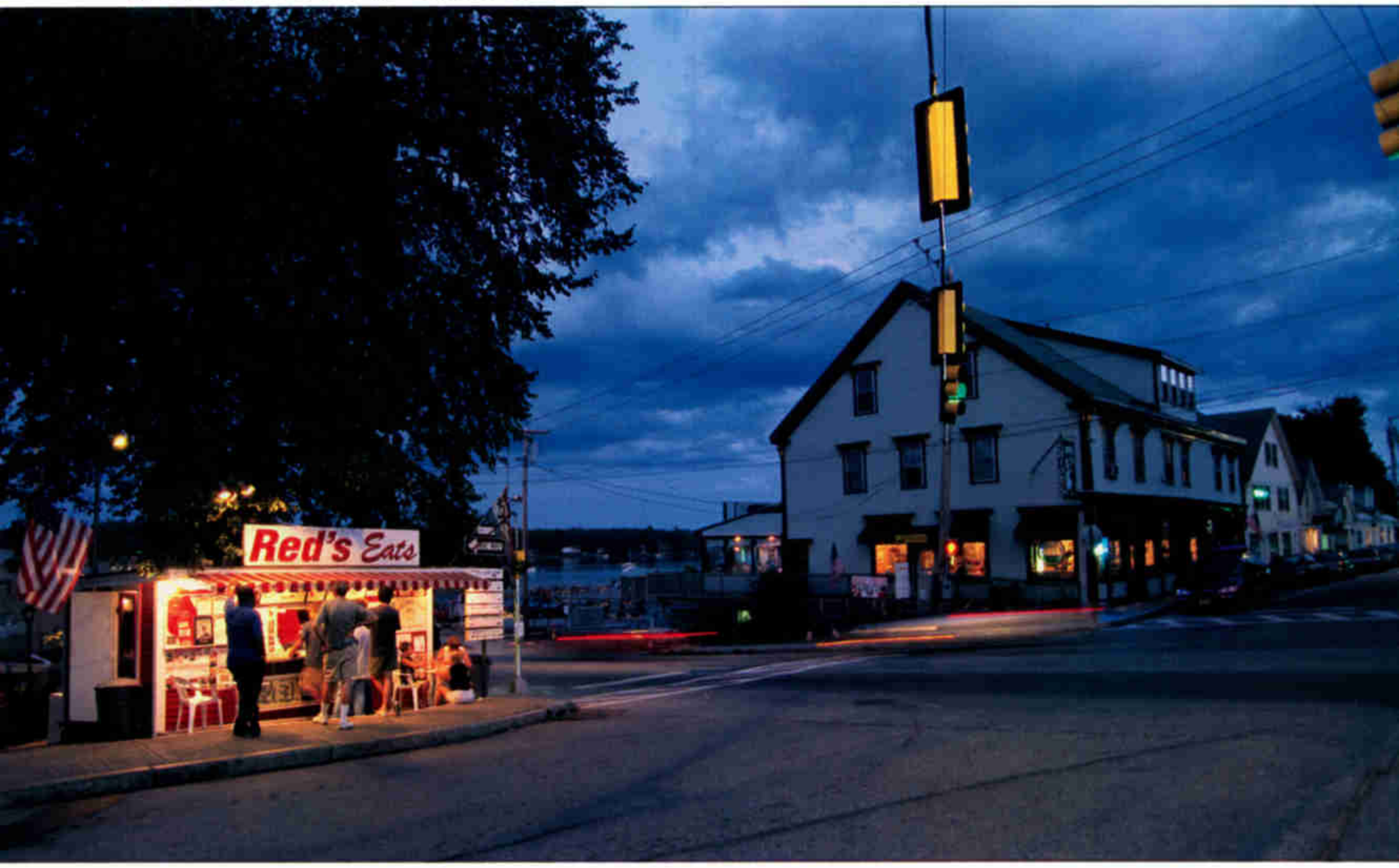
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Worm Capital of the World

BY CATHY NEWMAN PHOTOGRAPHS BY JOSÉ AZEL
NATIONAL GEOGRAPHIC SENIOR WRITER

Worm wrangler Dennis Hill corrals his squirmy stock of bloodworms at Harbor Bait Company before shipping them to sport-fishermen and retailers across the U.S. These slimy carnivores never give Hill the creeps. "Why would they?" he asks.



WISCASSET, MAINE



After the daily tidal wave of summer traffic has receded on Main Street, also known as U.S. 1, a handful of vacationers place orders at Red's Eats. Daytime lines can be 75 deep, and last summer owner Al Gagnon served six tons of his legendary lobster rolls.

Worms aren't the first thing you see in the worm capital of the world. Instead, Wiscasset looks like a picture postcard. The best view is from the east, looking across the gray-green marshes of the Sheepscot River to the town, which sits on a hillside. Four white spires lift from the foliage in a tableau of vintage New England. On a roadside sign outside town, Wiscasset calls itself the prettiest village in Maine, but the origin of that sobriquet remains a mystery. "A bit of hubris," observed Chris Cooper, a columnist for the weekly *Wiscasset Newspaper*. "The sign ought to say: 'We're not a real town yet, but we're getting there.'"

Despite the acid overlay, his remark reflects the exasperation of a parent for an errant child. Wiscasset, like much of the Maine coast, has joined the Realm of Quaint. What once was hardware store, drugstore, and newsstand has become boutiques, antique stores (two dozen, at least), and a gourmet food shop where four and a half ounces of foie gras sells for $20.

"What we have now is a tourist business," Marguerite Rafter said. Mrs. Rafter, who married into a Wiscasset shipping family now ten generations old, lives in a 200-year-old house within sight and sound of U.S. 1, which also happens to be the town's Main Street. "You are lucky if you go downtown and know *anyone*," she said, as traffic rumbled past her living room window.

So what to do? I asked her contemporary, 86-year-old Jane Tucker.

A descendant of another old Wiscasset family, Miss Tucker until recently lived near the end of High Street, where the mercantile upper crust built their homes in the 1800s. Now a museum, Castle Tucker, as the mansion is known, is an architectural chowder: part federal, part Victorian, with a dash of Scottish castle. Miss Tucker, its steward, has pewter gray hair worn in a soft pageboy and piercing eyes behind big framed



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POPULATION: 4,350

WORM-DIGGING LICENSES (2003): 73

LOBSTER LICENSES (2003): 18

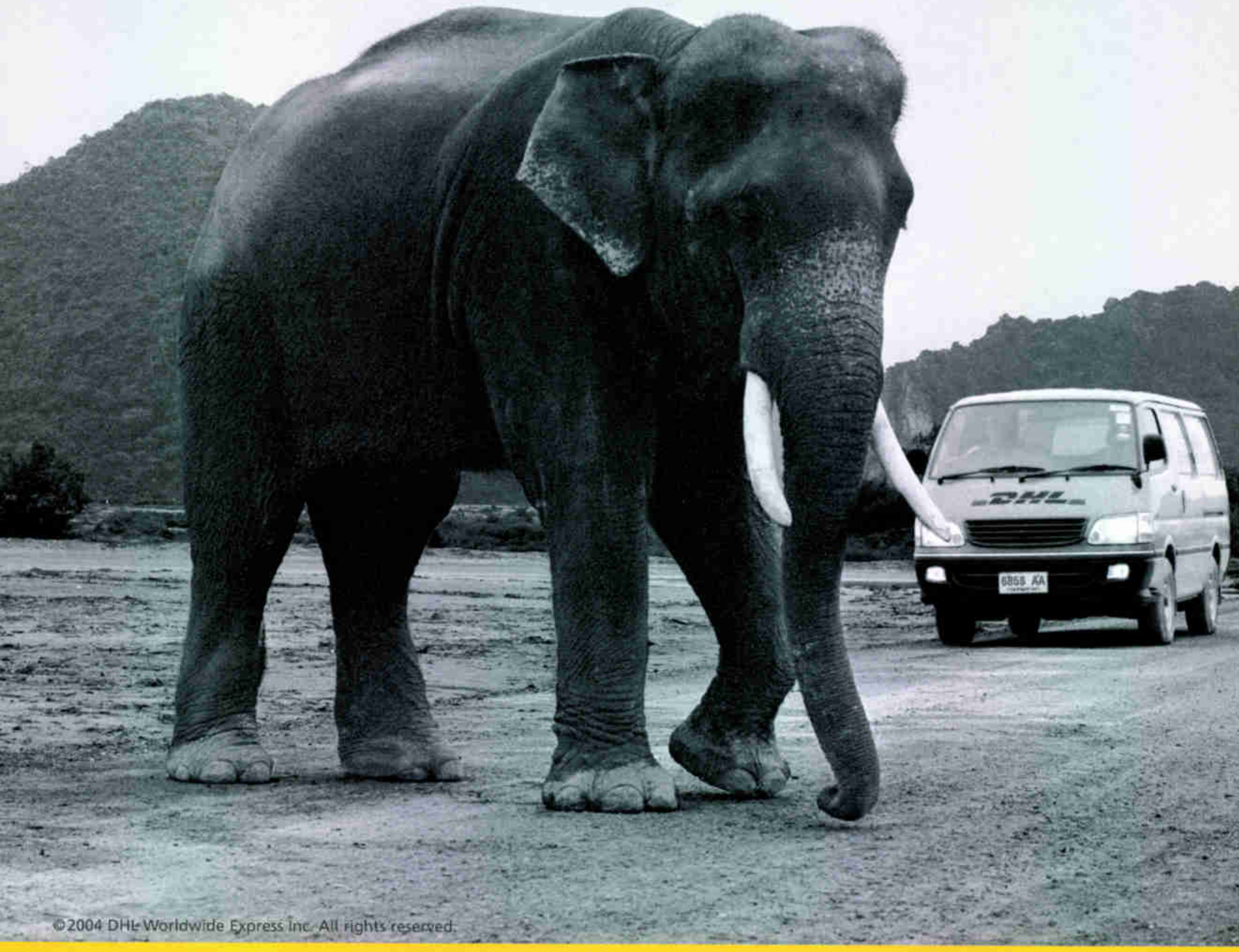
VALUE OF MAINE WORMS (2002): $8 million

PEAK DAILY SUMMER TRAFFIC, MAIN STREET: About 26,000 cars

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glasses. Her answer, like Miss Tucker herself, was direct and unsparing. "What to do? Why, *die*. Get out of the way," she said.

Wiscasset's claim to worm capital of the world, like its prettiest village status, may not be provable but is certainly believable.

We're talking bloodworms and sandworms here. If you're a bait fisherman, you know exactly what that means. If not, then take it on faith that worms are to a flounder what foie gras is to a Frenchman—a delicacy to die for. A fisherman in California will happily fork over 50 cents a worm for the pleasure of placing a wriggling piece of slime on the hook in hopes of catching The Big One.

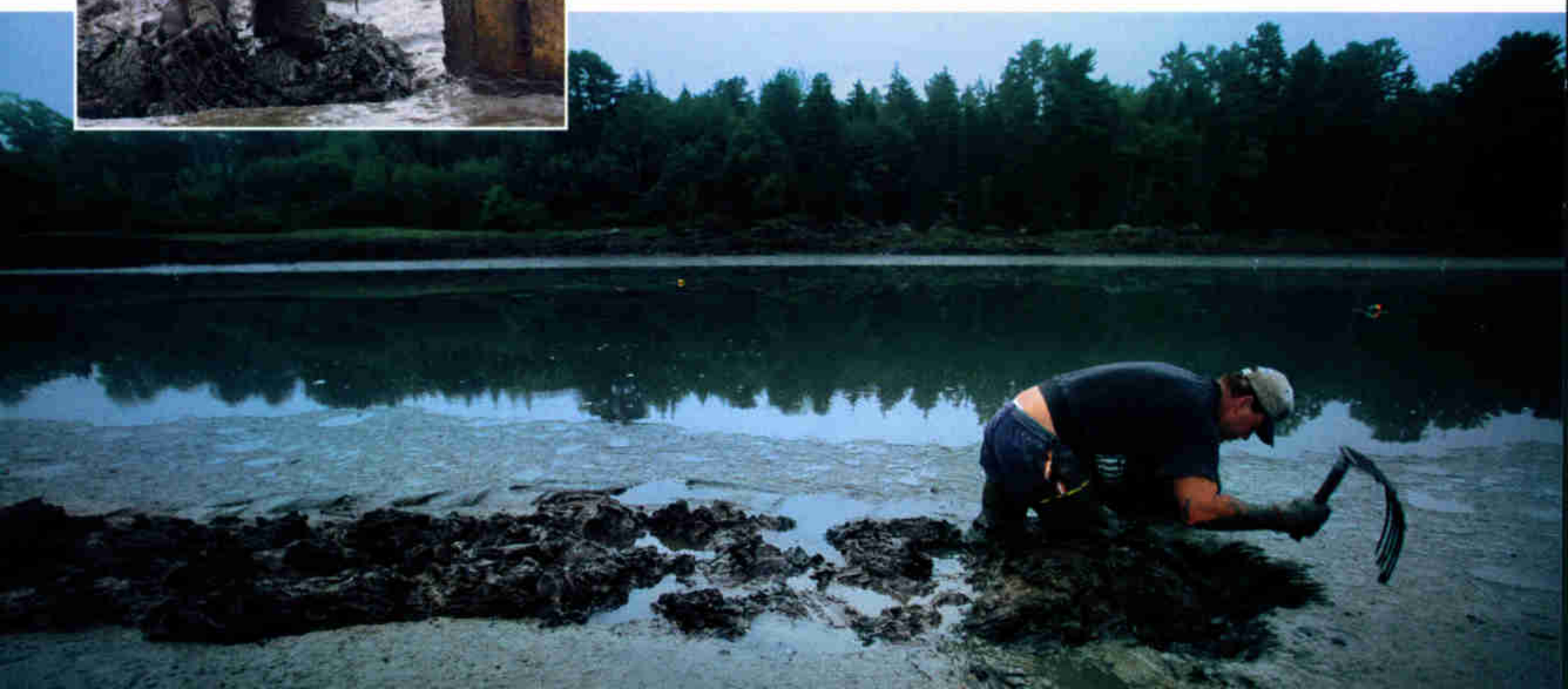
A worm digger works knee-deep in taupe-colored, fetid mud that clings to legs like a drowning man to a buoy. At my behest Doug Schmal, a third-generation digger, took me out on the mudflats. Watch that first step out of the boat. Mine was a disaster. I sank deep in mud, hopelessly stuck. Knowing I could never break loose, I left my boots in the mud, slogged to higher, solid ground, and sat on a rock while Schmal pulled them out. Then I watched him hack through the muck with his hoe in search of his quarry. Smirk if you like at the idea of digging worms: On a good day Schmal makes $180 for five hours' work (at 12 cents a sandworm, that adds up to 1,500 worms) and takes the rest of the day off to play golf. Of course there are $30 days, and, he hastens to add, "I have a hardworking wife who helps support me."

The prime hangout for worm diggers is the Miss Wiscasset Diner south of town, where U.S. 1 becomes the town's commercial strip. The usual roadside flora prevails: gas stations, motels, a trailer or two, and Big Al's Super Values. Big Al is Al Cohen, the self-proclaimed Undertaker of Merchandise,



David Cronk (above) piles sandworms in his bait cellar, where he pays diggers like childhood pal Doug Schmal (below and left) 12 cents a worm. "It's a backbreaking job, but it gets in your blood," says Schmal, a third-generation digger who toils in the "gooey, sloppy" mudflats of the Back River.







Four miles upriver from town a freestyle kayaker surfs the onrushing tide at Sheepscot Reversing Falls. "It's a balancing act, like riding a bucking bronco," says river guide "Dutch" Holland, who has the scars to prove it. "Wiscasset is very much tied to the water. Everybody lives by a tide chart here."

and Wiscasset has never known a bigger booster, even though he is, in local parlance, "from away." Big Al (who at 300 pounds lives up to his name) is from Queens, New York. He immigrated to Maine 16 years ago after being robbed three times in six months.

"There are people who decorate their house in Modern Big Al's and Antique Salvation Army," Al said, showing me his merchandise, which consists of manufacturers' overstocks and odd-lot leftovers from catalog houses. He picked up a plastic bird from a bin. "Don't You Know You Need One Of These?" he said in his TV voice. (Big Al stars in his own television commercials.)

"Is it an ostrich?" I asked.

"Not an ostrich," he corrected. "Here they should know from ostriches? This is a Lawn Bird." He picked up a ceramic bowl and offered another marketing lesson. "In some places this is a pasta dish." It was one of a huge lot of bowls that didn't sell—at first. "Then I called them *chowdah* bowls. Now I sell 230 cases a year." That's Yankee ingenuity by way of Queens for you.

We moved on. "And Don't You Need One Of These?" he boomed, lifting a coffee mug shaped like a cow's hindquarters.

A woman in the adjacent aisle pricked up her ears and headed our way.

"Get it before it's gone," he said.

She practically broke into a run.

"Life's been good to you?" I asked him.

"Can't complain. I won the lottery," he said, by which he meant the jackpot in the lottery of life. "I came to Maine."

I stopped by the counter to choose my Free Gift (Big Al has the Only Free Gift Bar In Maine!) and couldn't decide between a ring made of indeterminate metal with LOVE on it, or one with a peace sign.

"Take both," said Big Al.

Why not? I should get it before it's gone. □

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Final Edit



KONRAD WOTHE, MINDEN PICTURES

CRANES

Crowning Glory

"If Audrey Hepburn were a bird, she'd be this one," says photo editor Kathy Moran of the grey crowned crane above. "The photo added elegance and serenity to the slides we were considering," most of which were images of birds in raucous, sometimes comical, displays. But in the end the editors chose to represent this particular species with the image of a flock roosting in a tree (page 55). "Context was important," explains Moran. "We needed to use a photo that says something about habitat and behavior. This one says *Breakfast at Tiffany's.*"

WEBSITE EXCLUSIVE

Cut it or keep it? Find out more about what tipped the balance for this photo and send it as an electronic greeting card in Final Edit at **nationalgeographic.com/magazine/0404.**

It's different
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It's not just heartburn you may have to worry about, but the threat of a damaged esophagus.

If you suffer from acid reflux disease, any food can trigger an attack of heartburn. And over time, all that churning acid could do real harm to your esophagus. So, if you've changed your diet and treated your symptoms, but the heartburn still comes back two or more days a week, ask your doctor about prescription NEXIUM.

Unlike your stomach, the lining of your esophagus offers little protection against churning acid. When acid rises into the esophagus–even if you feel only a little heartburn–it can eventually wear away the lining. This condition is called erosive esophagitis and only a doctor can determine if you have it.

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NEXIUM has a low occurrence of side effects, the most common being headache, diarrhea, and abdominal pain. Symptom relief does not rule out serious stomach conditions.

Next time, ask your doctor about NEXIUM. The Healing Purple Pill. **Healing Is Such A Great Feeling.**

AstraZeneca

Please read the important Product Information about NEXIUM on the following page and discuss it with your doctor.

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Nexium® *(esomeprazole magnesium)*

20-MG, 40-MG Delayed-Release Capsules

BRIEF SUMMARY Before prescribing NEXIUM, please see full Prescribing Information. **INDICATIONS AND USAGE** NEXIUM is indicated for the short-term treatment (4 to 8 weeks) in the healing and symptomatic resolution of diagnostically confirmed erosive esophagitis. **CONTRAINDICATIONS** NEXIUM is contraindicated in patients with known hypersensitivity to any component of the formulation or to substituted benzimidazoles. **PRECAUTIONS** Symptomatic response to therapy with NEXIUM does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole, of which NEXIUM is an enantiomer. **Information for Patients:** NEXIUM Delayed-Release Capsules should be taken at least one hour before meals. For patients who have difficulty swallowing capsules, one tablespoon of applesauce can be added to an empty bowl and the NEXIUM Delayed-Release Capsule opened, and the pellets carefully emptied onto the applesauce. The pellets should be mixed with the applesauce and then swallowed immediately. The applesauce used should not be hot and should be soft enough to be swallowed without chewing. The pellets should not be chewed or crushed. The pellet/applesauce mixture should not be stored for future use. Antacids may be used while taking NEXIUM. **Drug Interactions:** Esomeprazole is extensively metabolized in the liver by CYP2C19 and CYP3A4. *In vitro* and *in vivo* studies have shown that esomeprazole is not likely to inhibit CYPs 1A2, 2A6, 2C9, 2D6, 2E1 and 3A4. No clinically relevant interactions with drugs metabolized by these CYP enzymes would be expected. Drug interaction studies have shown that esomeprazole does not have any clinically significant interactions with phenytoin, warfarin, quinidine, clarithromycin or amoxicillin. Post-marketing reports of changes in prothrombin measures have been received among patients on concomitant warfarin and esomeprazole therapy. Increases in INR and prothrombin time may lead to abnormal bleeding and even death. Patients treated with proton pump inhibitors and warfarin concomitantly may need to be monitored for increases in INR and prothrombin time. Esomeprazole may potentially interfere with CYP2C19, the major esomeprazole metabolizing enzyme. Coadministration of esomeprazole 30 mg and diazepam, a CYP2C19 substrate, resulted in a 45% decrease in clearance of diazepam. Increased plasma levels of diazepam were observed 12 hours after dosing and onwards. However, at that time, the plasma levels of diazepam were below the therapeutic interval, and thus this interaction is unlikely to be of clinical relevance. Esomeprazole inhibits gastric acid secretion. Therefore, esomeprazole may interfere with the absorption of drugs where gastric pH is an important determinant of bioavailability (eg, ketoconazole, iron salts and digoxin). Coadministration of oral contraceptives, diazepam, phenytoin, or quinidine did not seem to change the pharmacokinetic profile of esomeprazole. **Carcinogenesis, Mutagenesis, Impairment of Fertility:** The carcinogenic potential of esomeprazole was assessed using omeprazole studies. In two 24-month oral carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (about 0.7 to 57 times the human dose of 20 mg/day expressed on a body surface area basis) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg omeprazole/kg/day (about 5.6 times the human dose on a body surface area basis) for 1 year, then followed for an additional year without the drug. No carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of 1 year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. Gastric adenocarcinoma was seen in one rat (2%). No similar tumor was seen in male or female rats treated for 2 years. For this strain of rat no similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Esomeprazole was negative in the Ames mutation test, in the *in vivo* rat bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. Esomeprazole, however, was positive in the *in vitro* human lymphocyte chromosome aberration test. Omeprazole was positive in the *in vitro* human lymphocyte chromosome aberration test, the *in vivo* mouse bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. The potential effects of esomeprazole on fertility and reproductive performance were assessed using omeprazole studies. Omeprazole at oral doses up to 138 mg/kg/day in rats (about 56 times the human dose on a body surface area basis) was found to have no effect on reproductive performance of parental animals. **Pregnancy:** *Teratogenic Effects. Pregnancy Category B*— Teratology studies have been performed in rats at oral doses up to 280 mg/kg/day (about 57 times the human dose on a body surface area basis) and in rabbits at oral doses up to 86 mg/kg/day (about 35 times the human dose on a body surface area basis) and have revealed no evidence of impaired fertility or harm to the fetus due to esomeprazole. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed. Teratology studies conducted with omeprazole in rats at oral doses up to 138 mg/kg/day (about 56 times the human dose on a body surface area basis) and in rabbits at doses up to 69 mg/kg/day (about 56 times the human dose on a body surface area basis) did not disclose any evidence for a teratogenic potential of omeprazole. In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (about 5.5 to 56 times the human dose on a body surface area basis) produced dose-related increases in embryo-lethality, fetal resorptions, and pregnancy disruptions. In rats, dose-related embryo/fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole at 13.8 to 138.0 mg/kg/day (about 5.6 to 56 times the human doses on a body surface area basis). There are no adequate and well-controlled studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. **Nursing Mothers:** The excretion of esomeprazole in milk has not been studied. However, omeprazole concentrations have been measured in breast milk of a woman following oral administration of 20 mg. Because esomeprazole is likely to be excreted in human milk, because of the potential for serious adverse reactions in nursing infants from esomeprazole, and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. **Pediatric Use:** Safety and effectiveness in pediatric patients have not been established. **Geriatric Use:** Of the total number of patients who received NEXIUM in clinical trials, 778 were 65 to 74 years of age and 124 patients were ≥ 75 years of age. No overall differences in safety and efficacy were observed between the elderly and younger individuals, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out. **ADVERSE REACTIONS** The safety of NEXIUM was evaluated in over 10,000 patients (aged 18-84 years) in clinical trials worldwide including over 7,400 patients in the United States and over 2,600 patients in Europe and Canada. Over 2,900 patients were treated in long-term studies for up to 6-12 months. In general, NEXIUM was well tolerated in both short- and long-term clinical trials. The safety in the treatment of healing of erosive esophagitis was assessed in four randomized comparative clinical trials, which included 1,240 patients on NEXIUM 20 mg, 2,434 patients on NEXIUM 40 mg, and 3,008 patients on omeprazole 20 mg daily. The most frequently occurring adverse events (≥1%) in all three groups was headache (5.5, 5.0, and 3.8, respectively) and diarrhea (no difference among the three groups). Nausea, flatulence, abdominal pain, constipation, and dry mouth occurred at similar rates among patients taking NEXIUM or omeprazole. Additional adverse events that were reported as possibly or probably related to NEXIUM with an incidence < 1% are listed below by body system: ***Body as a Whole:*** abdomen enlarged, allergic reaction, asthenia, back pain, chest pain, chest pain substernal, facial edema, peripheral edema, hot flushes, fatigue, fever, flu-like disorder, generalized edema, leg edema, malaise, pain, rigors; ***Cardiovascular:*** flushing, hypertension, tachycardia; ***Endocrine:*** goiter; ***Gastrointestinal:*** bowel irregularity, constipation aggravated, dyspepsia, dysphagia, dysplasia GI, epigastric pain, eructation, esophageal disorder, frequent stools, gastroenteritis, GI hemorrhage, GI symptoms not otherwise specified, hiccup, melena, mouth disorder, pharynx disorder, rectal disorder, serum gastrin increased, tongue disorder, tongue edema, ulcerative stomatitis, vomiting; ***Hearing:*** earache, tinnitus; ***Hematologic:*** anemia, anemia hypochromic, cervical lymphoadenopathy, epistaxis, leukocytosis, leukopenia, thrombocytopenia; ***Hepatic:*** bilirubinemia, hepatic function abnormal, SGOT increased, SGPT increased; ***Metabolic/ Nutritional:*** glycosuria, hyperuricemia, hyponatremia, increased alkaline phosphatase, thirst, vitamin B12 deficiency, weight increase, weight decrease; ***Musculoskeletal:*** arthralgia, arthritis aggravated, arthropathy, cramps, fibromyalgia syndrome, hernia, polymyalgia rheumatica; ***Nervous System/Psychiatric:*** anorexia, apathy, appetite increased, confusion, depression aggravated, dizziness, hypertonia, nervousness, hypoesthesia, impotence, insomnia, migraine, migraine aggravated, paresthesia, sleep disorder, somnolence, tremor, vertigo, visual field defect; ***Reproductive:*** dysmenorrhea, menstrual disorder, vaginitis; ***Respiratory:*** asthma aggravated, coughing, dyspnea, larynx edema, pharyngitis, rhinitis, sinusitis; ***Skin and Appendages:*** acne, angioedema, dermatitis, pruritus, pruritus ani, rash, rash erythematous, rash maculo-papular, skin inflammation, sweating increased, urticaria; ***Special Senses:*** otitis media, parosmia, taste loss, taste perversion; ***Urogenital:*** abnormal urine, albuminuria, cystitis, dysuria, fungal infection, hematuria, micturition frequency, moniliasis, genital moniliasis, polyuria; ***Visual:*** conjunctivitis, vision abnormal. Endoscopic findings that were reported as adverse events include: duodenitis, esophagitis, esophageal stricture, esophageal ulceration, esophageal varices, gastric ulcer, gastritis, hernia, benign polyps or nodules, Barrett's esophagus, and mucosal discoloration. Postmarketing Reports – There have been spontaneous reports of adverse events with postmarketing use of esomeprazole. These reports have included rare cases of anaphylactic reaction. Other adverse events not observed with NEXIUM, but occurring with omeprazole can be found in the omeprazole package insert, **ADVERSE REACTIONS** section. **OVERDOSAGE** A single oral dose of esomeprazole at 510 mg/kg (about 103 times the human dose on a body surface area basis), was lethal to rats. The major signs of acute toxicity were reduced motor activity, changes in respiratory frequency, tremor, ataxia, and intermittent clonic convulsions. There have been some reports of overdosage with esomeprazole. Reports have been received of overdosage with omeprazole in humans. Doses ranged up to 2,400 mg (120 times the usual recommended clinical dose). Manifestations were variable, but included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, dry mouth, and other adverse reactions similar to those seen in normal clinical experience (see omeprazole package insert-**ADVERSE REACTIONS**). No specific antidote for esomeprazole is known. Since esomeprazole is extensively protein bound, it is not expected to be removed by dialysis. In the event of overdosage, treatment should be symptomatic and supportive. As with the management of any overdose, the possibility of multiple drug ingestion should be considered. For current information on treatment of any drug overdose, a certified Regional Poison Control Center should be contacted. Telephone numbers are listed in the Physicians' Desk Reference (PDR) or local telephone book.

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CHASING TORNADOES

Blown Away

Though built to stay put, the Tinman was a traveler

Carting around a 90-pound aluminum housing for his cameras over thousands of miles during three tornado seasons, **Carsten Peter** got used to stares. "In Roswell, New Mexico, people thought we had something to do with aliens," says the photographer. In the Manchester, South Dakota, tornado, he thought Tinman (the name for the device made by our photo engineers) might have gone with the wind. He almost put up wanted posters for it, but a day later he found it in a field—battered, but with pictures from a twister's-eye level still inside.

GNMENT

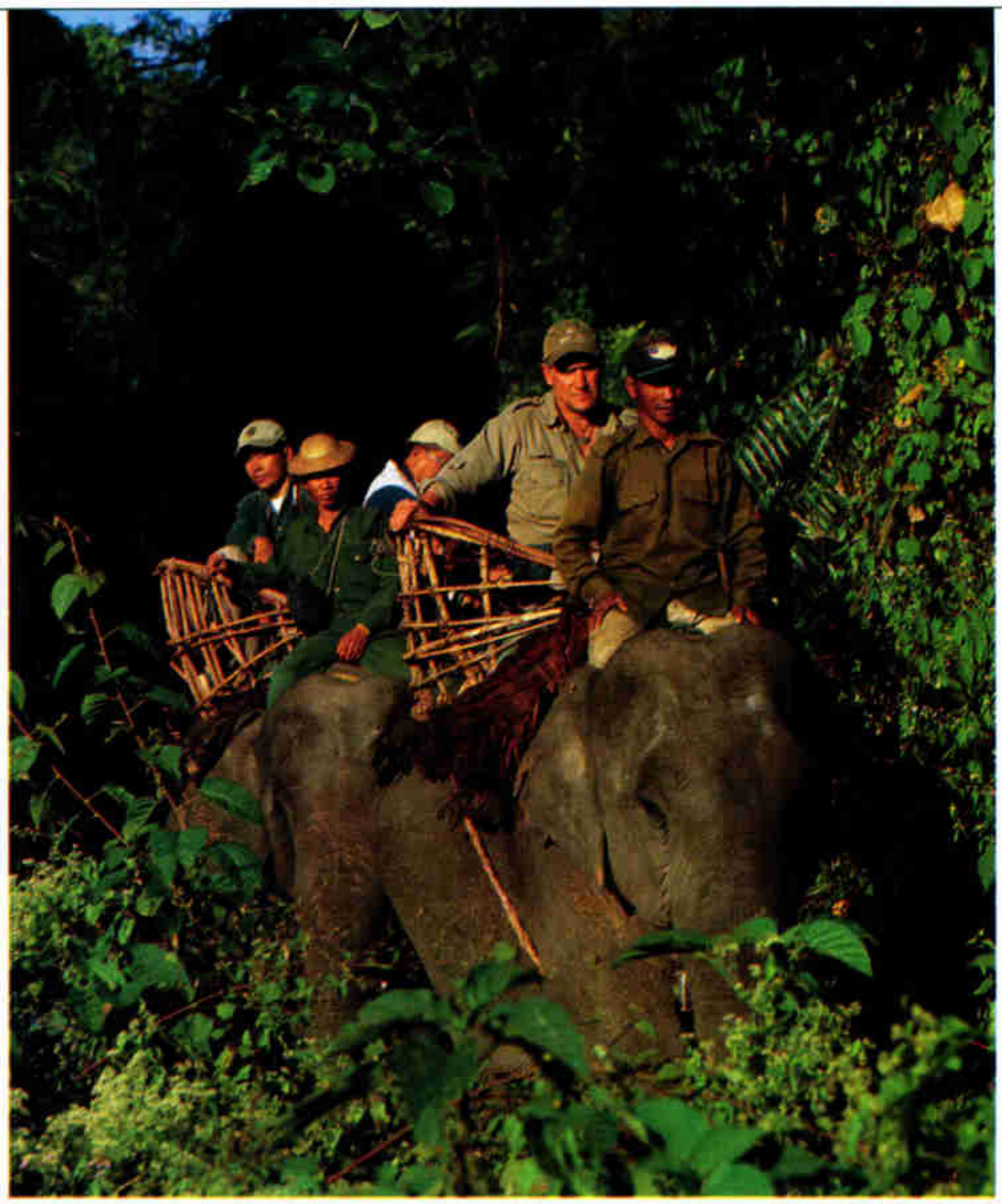
COVERING THE WORLD

CARSTEN PETER

HUKAWNG VALLEY

Enough With the Elephants

On the trail of tigers heard prowling near a Burmese village, biologist **Alan Rabinowitz,** second from right, found himself on an elephant. As the Wildlife Conservation Society's director of science and exploration, Alan is familiar with the behavior of big cats and has helped establish refuges for jaguars in Belize and tigers and leopards in Thailand. But he prefers to do his tracking on foot. Riding on a pachyderm, he found, was literally a pain in the behind. Elephants may be good for transporting gear, but they're "only fun to ride the first 20 minutes. After that," he says, "you get very sore."



STEVE WINTER (ABOVE); BENJY FRANCIS

WORLDWIDE

The photographs splashed across this Johannesburg minibus are meant to promote integration, explains photographer **Tomasz Tomaszewski** (below). The vehicle belongs to the director of the



Afrika Cultural Centre, which offers art classes to local youth. But Tomasz says he didn't see much integration in Johannesburg. "When I went down the street with my local guide, everybody would turn to look at a black guy and a white guy walking together." Because of the city's high crime rate, he says, Johannesburg was a difficult place to work: He had to shoot fast and move quickly to avoid attracting attention.

The foot-long worms inhabiting the thick tidal mud of Wiscasset, Maine, are famous as fishing bait. "Of course I had to go worming there," says writer **Cathy Newman.** "It's the worm capital of the world." First she got some instructions on the proper technique for "mud walking" across the tidal flats. "There's a particular way you twist your foot and pop it up to break the suction," she says. "But I never got the hang of it." She soon experienced a sinking feeling—up to her knees. As she struggled to pull her leg out of the mud, Cathy was laughing so hard that she sank even deeper. She could only free herself by abandoning her boots to the muck. They were later recovered, but her socks went into the trash. "When I went to the local Laundromat to wash the rest of my mud-covered clothes, I thought I'd probably get thrown out." She was wrong. "The lady who ran the place just looked at the mess and said, 'Digging worms?'"

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Tell your doctor if you have liver or kidney disease, or a history of angina, heart attack, or a blocked artery in your heart. VIOXX cannot take the place of aspirin for the prevention of heart attack or stroke. VIOXX should not be used by women in late pregnancy.

In clinical studies, commonly reported side effects included upper respiratory infection, diarrhea, nausea, and high blood pressure. Report any unusual symptoms to your doctor.

Please see the Patient Product Information for VIOXX on the next page for additional information that should be discussed with your doctor.

ONCE DAILY
VIOXX®
(rofecoxib)

FOR EVERYDAY VICTORIES

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Patient Information about
VIOXX® (rofecoxib tablets and oral suspension)
VIOXX® (pronounced "VI-ox")
for Osteoarthritis, Rheumatoid Arthritis and Pain
Generic name: rofecoxib ("ro-fa-COX-ib")

You should read this information before you start taking VIOXX*. Also, read the leaflet each time you refill your prescription, in case any information has changed. This leaflet provides only a summary of certain information about VIOXX. Your doctor or pharmacist can give you an additional leaflet that is written for health professionals that contains more complete information. This leaflet does not take the place of careful discussions with your doctor. You and your doctor should discuss VIOXX when you start taking your medicine and at regular checkups.

What is VIOXX?

VIOXX is a nonsteroidal anti-inflammatory drug (NSAID) that is used to reduce pain and inflammation (swelling and soreness). VIOXX is available as a tablet or a liquid that you take by mouth.

VIOXX is a medicine for:
- relief of osteoarthritis (the arthritis caused by age-related "wear and tear" on bones and joints)
- relief of rheumatoid arthritis in adults
- management of acute pain in adults (like the short-term pain you can get after a dental or surgical operation)
- treatment of menstrual pain (pain during women's monthly periods).

Who should not take VIOXX?

Do not take VIOXX if you:
- have had an allergic reaction such as asthma attacks, hives, or swelling of the throat and face to aspirin or other NSAIDs (for example, ibuprofen and naproxen).
- have had an allergic reaction to rofecoxib, which is the active ingredient of VIOXX, or to any of its inactive ingredients. (See Inactive Ingredients at the end of this leaflet.)

What should I tell my doctor before and during treatment with VIOXX?

Tell your doctor if you are:
- pregnant or plan to become pregnant. VIOXX should not be used in late pregnancy because it may harm the fetus.
- breast-feeding or plan to breast-feed. It is not known whether VIOXX is passed through to human breast milk and what its effects could be on a nursing child.

Tell your doctor if you have:
- history of angina, heart attack or a blocked artery in your heart
- kidney disease
- liver disease
- heart failure
- high blood pressure
- had an allergic reaction to aspirin or other NSAIDs
- had a serious stomach problem in the past.

Tell your doctor about:
- any other medical problems or allergies you have now or have had.
- all medicines that you are taking or plan to take, even those you can get without a prescription.

Tell your doctor if you develop:
- serious stomach problems such as ulcer or bleeding symptoms (for instance, stomach burning or black stools, which are signs of possible stomach bleeding).
- unexplained weight gain or swelling of the feet and/or legs.
- skin rash or allergic reactions. If you have a severe allergic reaction, get medical help right away.

How should I take VIOXX?

VIOXX should be taken once a day. Your doctor will decide what dose of VIOXX you should take and how long you should take it. You may take VIOXX with or without food.

Can I take VIOXX with other medicines?

Tell your doctor about all of the other medicines you are taking or plan to take while you are on VIOXX, even other medicines that you can get without a prescription. Your doctor may want to check that your medicines are working properly together if you are taking other medicines such as:
- warfarin (a blood thinner)
- theophylline (a medicine used to treat asthma)
- rifampin (an antibiotic)
- ACE inhibitors (medicines used for high blood pressure and heart failure)
- lithium (a medicine used to treat a certain type of depression).

VIOXX cannot take the place of aspirin for prevention of heart attack or stroke. If you take both aspirin and VIOXX, you may have a greater chance of serious stomach problems than if you take VIOXX alone. If you are currently taking aspirin for prevention of heart attack or stroke, you should not discontinue taking aspirin without consulting your doctor.

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What are the possible side effects of VIOXX?

Serious but rare side effects that have been reported in patients taking VIOXX and/or related medicines have included:

- Serious stomach problems, such as stomach and intestinal bleeding, can occur with or without warning symptoms. These problems, if severe, could lead to hospitalization or death. Although this happens rarely, you should watch for signs that you may have this serious side effect and tell your doctor right away.

- Heart attacks and similar serious events have been reported in patients taking VIOXX.

- Serious allergic reactions including swelling of the face, lips, tongue, and/or throat which may cause difficulty breathing or swallowing and wheezing occur rarely but may require treatment right away. Severe skin reactions have also been reported.

- Serious kidney problems occur rarely, including acute kidney failure and worsening of chronic kidney failure.

- Severe liver problems, including hepatitis, jaundice and liver failure, occur rarely in patients taking NSAIDs, including VIOXX. Tell your doctor if you develop symptoms of liver problems. These include nausea, tiredness, itching, tenderness in the right upper abdomen, and flu-like symptoms.

In addition, the following side effects have been reported: anxiety, blurred vision, colitis, confusion, constipation, decreased levels of sodium in the blood, depression, fluid in the lungs, hair loss, hallucinations, increased levels of potassium in the blood, insomnia, low blood cell counts, menstrual disorder, palpitations, pancreatitis, ringing in the ears, severe increase in blood pressure, tingling sensation, unusual headache with stiff neck (aseptic meningitis), vertigo, worsening of epilepsy.

More common, but less serious side effects reported with VIOXX have included the following:

Upper and/or lower respiratory infection and/or inflammation
Headache
Dizziness
Diarrhea
Nausea and/or vomiting
Heartburn, stomach pain and upset
Swelling of the legs and/or feet
High blood pressure
Back pain
Tiredness
Urinary tract infection.

These side effects were reported in at least 2% of osteoarthritis patients receiving daily doses of VIOXX 12.5 mg to 25 mg in clinical studies.

The side effects described above do not include all of the side effects reported with VIOXX. Do not rely on this leaflet alone for information about side effects. Your doctor or pharmacist can discuss with you a more complete list of side effects. Any time you have a medical problem you think may be related to VIOXX, talk to your doctor.

What else can I do to help manage my arthritis pain?

Talk to your doctor about:
- Exercise
- Controlling your weight
- Hot and cold treatments
- Using support devices.

What else should I know about VIOXX?

This leaflet provides a summary of certain information about VIOXX. If you have any questions or concerns about VIOXX, osteoarthritis, rheumatoid arthritis or pain, talk to your health professional. Your pharmacist can give you an additional leaflet that is written for health professionals.

Do not share VIOXX with anyone else; it was prescribed only for you. It should be taken only for the condition for which it was prescribed.

Keep VIOXX and all medicines out of the reach of children.

Inactive Ingredients:

Oral suspension: citric acid (monohydrate), sodium citrate (dihydrate), sorbitol solution, strawberry flavor, xanthan gum, sodium methylparaben, sodium propylparaben.

Tablets: croscarmellose sodium, hydroxypropyl cellulose, lactose, magnesium stearate, microcrystalline cellulose, and yellow ferric oxide.

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MERCK & CO., Inc.
Whitehouse Station, NJ 08889, USA 20450155(2)(911)-VIO-CON

Legal Notice

If You Are the Current or Former Owner of Property in which Entran II Hose was or is used for Radiant Heating or Snowmelting

You could get a payment from a class action settlement.

There is a proposed Settlement of two class action lawsuits, *Galanti v. The Goodyear Tire & Rubber Company* and *Kelman v. The Goodyear Tire & Rubber Company*. The first lawsuit is pending in the United States District Court for the District of New Jersey. The second lawsuit is pending in the Ontario Superior Court in Canada. The lawsuits concern Entran II hose used in the United States and Canada. (The lawsuit does not include Massachusetts, New Hampshire, Maine, Vermont, Connecticut and Rhode Island.) Entran II was manufactured and sold by The Goodyear Tire & Rubber Company ("Defendant").

What is the Litigation About?

Plaintiffs allege that the Defendant manufactured defective Entran II hose. The product was used in radiant heating and snow melting systems. They claim the hose is prone to leaking when operated under normal conditions. Entran II was also known as *Twintran, Nytrace, Entran II Trace, Entran II Wire, Entran 2, Entran 2 Trace*, and *Entran 2 Wire*. Defendant denies all claims of wrongdoing made by Plaintiffs. Defendant believes that if properly maintained Entran II hoses do not cause a problem.

Who is Involved?

You may be a member of the Settlement Class if you are the current or former owner of property in which the Entran II hose has been installed. The property must be in the United States, its territories and possessions or Canada. If you own or owned property in Massachusetts, New Hampshire, Maine, Vermont, Connecticut or Rhode Island, in which Entran II was or is installed, you are not part of this lawsuit. To see if your hose is covered by this Settlement you should check the Settlement Website or call the toll free number below.

What are the Settlement Terms?

The Settlement Fund will be between $196 million and $236 million. Defendants will pay this amount over a five (5) year period. Depending upon the number of claims, Class Counsel estimate some Class Members may receive as much as 40% of the cost of remediation. Information on the specific relief Class Members can expect is detailed in a document called the Plan of Allocation and Distribution. Class Counsel developed the Plan with the assistance of the Special Master, appointed by the Court, and other interested parties. The Plan is available on the Settlement Website or by calling the number below.

Class Counsel will petition the Court for reasonable attorneys' fees. These fees will not exceed $58.8 million or 30% of the Settlement Fund, and expenses payable from the Settlement Fund.

Entran II is an orange rubber hose used in radiant hydronic heating and snowmelt systems, usually stamped with the name "Heatway" or "Heatway Systems" on the outside.

What Are My Legal Rights?

- **If you wish to remain a member of the Settlement Class**, you do not have to do anything. But, to share in the Settlement Fund you must file a claim as discussed below. If the Court approves the proposed Settlement, you will receive the benefits of the proposed Settlement. You will also be bound by all the Court's orders. This means you will drop any claims you may have against the Defendant that are covered by the Settlement.

- **If you wish to file a claim,** you must complete a Claim Form. You can get a Claim Form by contacting the Claims Administrator in writing, at the address given below, or by calling the toll-free number. It is also available on the Settlement Website. Claim Forms must be signed and postmarked no later than October 19, 2009.

- **If you do not wish to be a member of the Settlement Class**, you must sign a Request For Exclusion letter as outlined in the Settlement Agreement and Notice. Your request must be postmarked no later than May 7, 2004.

When Will the Settlement be Approved?

The United States District Court for the District of New Jersey will hold a Fairness Hearing to decide if the proposed Settlement is fair, reasonable and adequate on October 19, 2004. The Court will hold a separate second Hearing to consider Class Counsel's request for attorneys' fees, on November 3, 2004. Both Hearings will be held at 10:00 a.m. at the United States District Court for the District of New Jersey, 402 East State Street, Room 2020, Trenton, N.J. 08608.

In addition, the Ontario Superior Court will also hold a Fairness Hearing to decide if the proposed Settlement is fair, reasonable and adequate. When that date is determined, it will be posted in the Canadian Notices and at www.entraniisettlement.com.

If you remain a member of the Settlement Class, you or your counsel have the right to appear before the Court and object to the Settlement. However, in order to object, you must file a written objection, as outlined in the Settlement Agreement and Long Form Notice. Objections must be filed by May 7, 2004.

For Information on the Proposed Settlement, Your Rights and a Copy of the Notice and Claim Form:

Visit: www.entraniisettlement.com Call: 1-800-254-9222

or Write: Entran II Claims Administrator, P.O. Box 24, Minneapolis, Minnesota 55440-0024

PLEASE DO NOT CALL THE COURT.

Flashback



JOSEPH F. ROCK

MYANMAR

Tiger Territory

"What was to be done about the tiger?" Joseph Rock asked in his March 1922 article, "Hunting the Chaulmoogra Tree." In Burma (now Myanmar) on an expedition to gather rare seeds, Rock—a legendary explorer and botanist—visited a village terrorized by this wild cat. Two women had been killed, another badly wounded, and a two-year-old girl was missing. "All we found was a trail of blood which led into the forest," Rock wrote.

"I shall never forget how the poor husbands of the slain women worked on that trap," Rock recalled of the snare the villagers set. It got results. "The captured creature's rage was terrible to behold," and after "only a few minutes . . . 20 spears ended its savage existence." The next day the grieving villagers woke to find "the sky still weeping over all this tragedy." —*Margaret G. Zackowitz*

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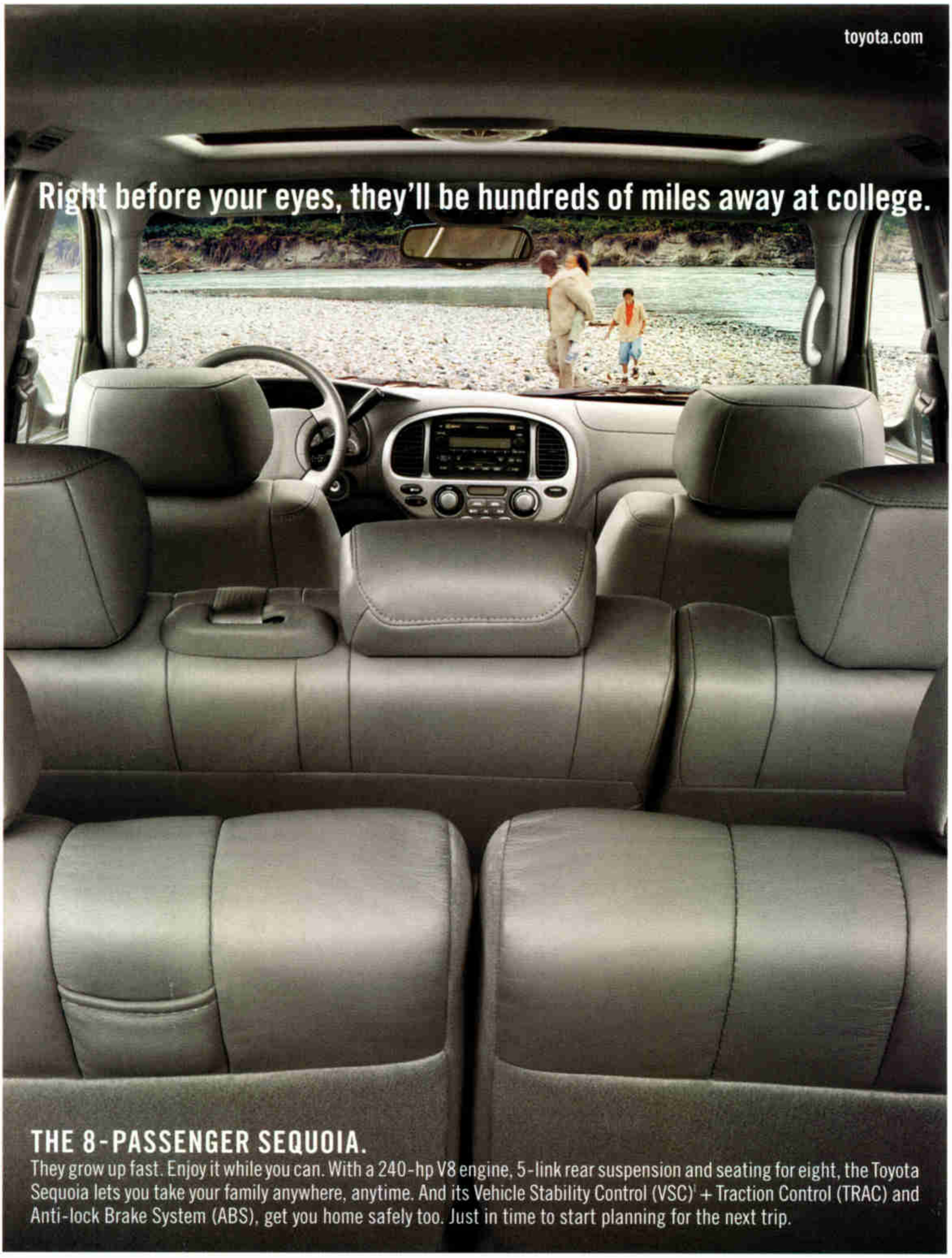
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Pj's ok.

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HOUSE BLEND
STARBUCKS COFFEE
GROUND

Look for Starbucks® coffee at your grocery store
and bring the rich, distinctive taste home.



Vehicle shown with available equipment. [1]Toyota Vehicle Stability Control (VSC) is an electronic system designed to help the driver maintain vehicle control under adverse conditions. It is not a substitute for safe driving practices. Factors including speed, road conditions and driver steering input can all affect whether VSC will be effective in preventing a loss of control. Please see your *Owner's Manual* for further details. ©2003 Toyota Motor Sales, U.S.A., Inc.